



EMPTY OCEAN CONTAINER LOGISTICS STUDY



Report To:

**Gateway Cities Council of Governments
Port of Long Beach
Southern California Association of Governments**

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May 8, 2002

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I. Executive Summary

Background

In a perfectly balanced trading environment, every import container arriving on the West Coast would be filled with an outbound load. Current containerized trade through San Pedro Bay, however, is severely imbalanced, and has markedly increased empty container flows. The problem is exacerbated by the sheer volume of containers moving through a major urban area that already has serious traffic congestion and air quality concerns.

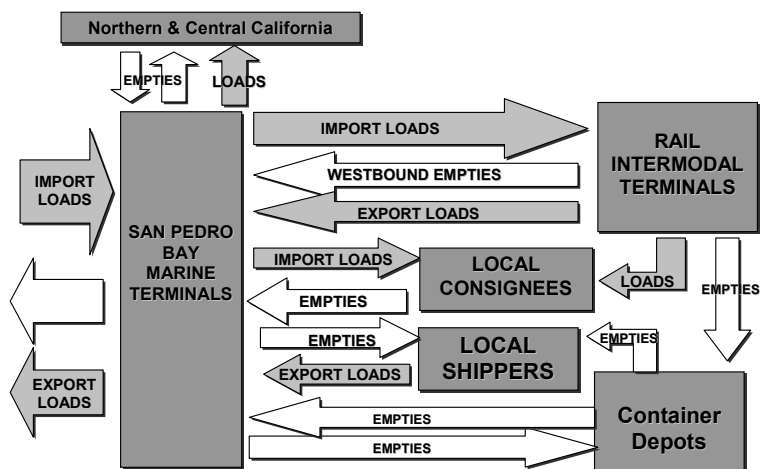
Empty containers used for import loads are typically drayed back to marine terminals. Exporters draw a supply of empty containers from the terminals, returning loaded boxes the other way. “Street turns” — reusing import containers for export loads without first returning them to the marine terminal — are regarded by all parties as highly desirable, but hard to achieve.

Information systems promise to increase street turns by assisting drayage firms to identify import/export linkages and quickly locate suitable containers for export loads. The development and eventual implementation of a practical, effective empty container logistics plan driven by an Internet-based information system has significant potential to ameliorate the serious empty container problem facing Southern California.

Empty Container Flows

As the flow chart at right illustrates, there is not just one empty container flow, but a number of individual flows.

Although the total number of empty containers moving through the SCAG region is documented, individual flow components must be estimated. The approach taken in this study combines data from the Long-Term Cargo Forecast and the Transportation Master Plan with results from stakeholder interviews. Elements of the estimates are necessarily judgmental since there is no comprehensive data source and the informal estimates of stakeholders cannot be assembled into a rigorous statistical analysis or database.



- The study team has estimated that in the year 2000 about 716,000 empty containers moved eastbound from the marine terminals to local or regional inland destinations via rail and truck.

- The westbound flow includes intermodal empties from inland points, empty containers from local import loads, and other smaller flows totaling about 1.9 million units in 2000.
- Non-port “cross-town” empty flows that neither originate nor end at port terminals, an estimated 80,000 moves in 2000, include local “depot-direct” off-hires of leasing company containers, intermodal depot-direct off-hiring, and empties reused for local exports.

Based on study team estimates and forecasts, the number of empty containers moving through the SCAG region will roughly quadruple between 2000 and 2020. The number of empties grows faster than overall trade because of the growing imbalance.

Empty Container Logistics

The parties in the container business and logistics chain attempt to minimize the total cost of maintaining the desired level of service and adequate capacity. Industry fragmentation and practices affect the movements of empty containers and the awareness of potential matching loads.

Interchange, the transfer of a container (and usually a chassis) from the responsibility of one party to the responsibility of another, is the defining characteristic of intermodal transportation. There are three types of interchange at stake in this study:

- Interchanges between ocean carriers and motor carriers
- Interchanges between motor carriers and depot operators
- Interchanges between motor carriers, also known as “street interchanges”

To move over the highway a container must be mounted on a chassis, a specialized trailer with fittings for secure attachment of the box. Chassis logistics are a major limiting factor in empty container logistics. Even when an ocean carrier has no immediate need for a specific empty container to be returned, it may have a pressing need to use the chassis for another movement.

Roughly half of all containers in the world fleet are owned by leasing companies. These containers are leased to ocean carriers under “master lease” arrangements that spell out rates, the number of container to be leased, and procedures for “on-hiring” (leasing more containers) and “off-hiring” (returning containers not currently needed).

Containers are stored, maintained, and interchanged at two principal locations: the marine terminal container yards (CYs), and the off-dock container depots. The marine terminal CYs are part of the port terminal complex and operated by the marine terminal operators on behalf of the ocean carriers. Container depots are usually owned and operated by separate, specialized firms.

Virtual Container Yard Concept

A container yard is a physical location, and at the heart of the empty container logistics issue are the numerous trips required to move containers back and forth. Containers move back and forth because at present there is no alternative. Much of the work done at the CY or at the gates that mark its boundaries is the paperwork or electronic equivalent for the interchange process.

A conceptual alternative to the physical container yard has come to be known as a virtual container yard (or “virtual CY”). The key purposes of a virtual CY are to:

- post needed information about containers (status, location, etc.),
- facilitate communication between parties (motor carriers, ocean carriers, leasing companies, chassis pool operators, et al),
- permit equipment interchange and other processes to take place without moving the container to the harbor, and
- assist the parties to make optimal decisions regarding container logistics (return, reuse, interchange, etc.), rationalize moves, and plan ahead.

The virtual CY, like its physical counterpart, would be a place where the containers are interchanged and the required paperwork is completed, both electronically. The technical demands of a virtual CY are modest. Its major functions are to allow posting of critical information and serve as a conduit for communication. The virtual CY would facilitate good

<i>Info Source</i>	<i>Container Info</i>	<i>Chassis Info</i>
Ocean Carrier	Box Serial No.	Chassis Serial No.
	Box Type & Specs	Chassis Type
	Reuse Limits	Reuse Limits
	Return Location	Return Location
	Free Time/Per Diem	Free Time/Per Diem
Trucker	Location	Location
	Time/Date Available	Time/Date Available

decision making, not dispatch trucks or attempt to match containers with uses. One information system could serve both reuse and off-hire needs with the same information, as shown at left. This information would *not* tell a drayman where to locate an export reuse opportunity, but would simply assist the drayman to exploit opportunities the drayman has already located.

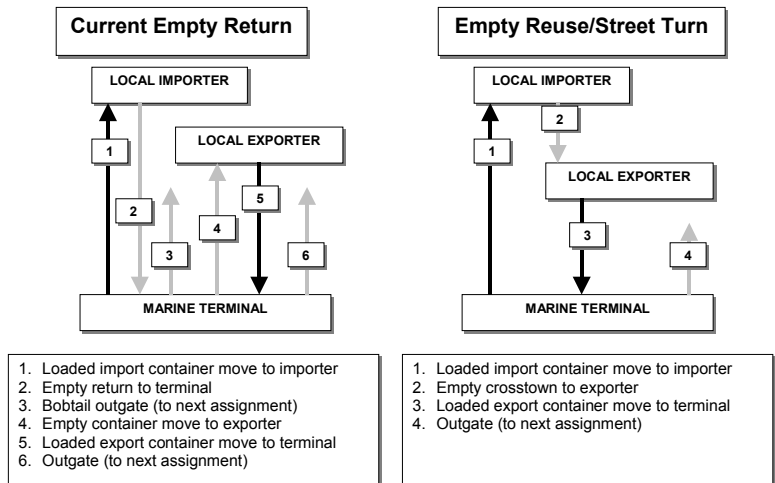
Potential for Empty Container Reuse

Over 1.1 million import containers were emptied in Southern California in 2000. Virtually all of these containers were trucked empty back to the marine terminals. At the same time, over 500,000 empty containers were trucked from the marine terminals to be loaded with exports. Determining the potential for empty container reuse was a major focus of this study.

Only an estimated 2% of the empty import containers handled by local draymen are reloaded (“street turned”) at present. For a variety of reasons only a small portion of the empty containers can ever be reused for export loads. The potential for expanded reuse may be roughly 5-10%. While an increase from 2% to 5% or 10% does not appear dramatic, the large number of containers at stake creates a substantial impact.

Intermodal industry participants already interchange empty containers to some extent. The problem is not that interchange of empty containers is impossible, but that it is uncommon and inconsistent in application. The study team found that drayage firms would like to increase interchange and reuse of empties, but are limited by informational, institutional, and competitive factors.

The adjacent chart shows the different trip patterns for the existing empty return norm and empty reuse or “street turns”. Each street turn entails three moves avoided and one move added, a net savings of two moves.



There are several key factors that severely limit the ability of truckers and ocean carriers to reuse empty import containers for exports.

- Import/export timing or location mismatch
- Ownership mismatch (e.g. wrong steamship line)
- Type mismatch (e.g. wrong size, wrong type, or tri-axle chassis required for heavy exports)
- Off-hiring of leased containers
- Lack of steamship line incentives

The table below shows the consequences of increasing the reuse of empty import containers from 2% at present to 5% (the “Tier I” scenario) and from 2% to 10% (the “Tier II” scenario).

	2000		2020	
Scenario	Additional Units Reused	Net Trip Reduction	Additional Units Reused	Net Trip Reduction
Tier I - 5% Reuse	39,842	86,457	160,365	347,992
Tier II - 10% Reuse	106,245	230,552	427,640	927,980

For the year 2000:

- The annual number of empties reused for export loads would rise from 26,561 in the Base Case to 66,403, an increase of 39,842 units, or about 109 per day.
- The net impact is a reduction of 86,457 annual truck trips, or an average of 237 trips per day.

- By 2020, an increase in reuse from 2% to 5% would save almost 348,000 annual truck trips, an average of 953 trips per day.

The impact would increase proportionately if reuse rose to 10%.

- The annual number of empties reused for export loads would rise from 26,561 in the Base Case to 132,806, an increase of 106,245 units, or about 291 per day.
- The net impact would be a reduction of 230,552 annual truck trips (including reduced bobtails) or an average of 632 trips per day.
- By 2020 the net reduction would be 927,980 annual trips, or about 2,542 truck trips per day.

The table shows slightly more than two net trips saved per street turn because there is also a small percentage reduction in off-hiring flows to depots.

Potential for Off-Dock Empty Return Depots

Some stakeholders and industry observers have suggested the establishment of off-dock empty return points to serve as buffer storage or neutral points for interchange and reuse. The objectives of establishing or expanding empty return depots would be to:

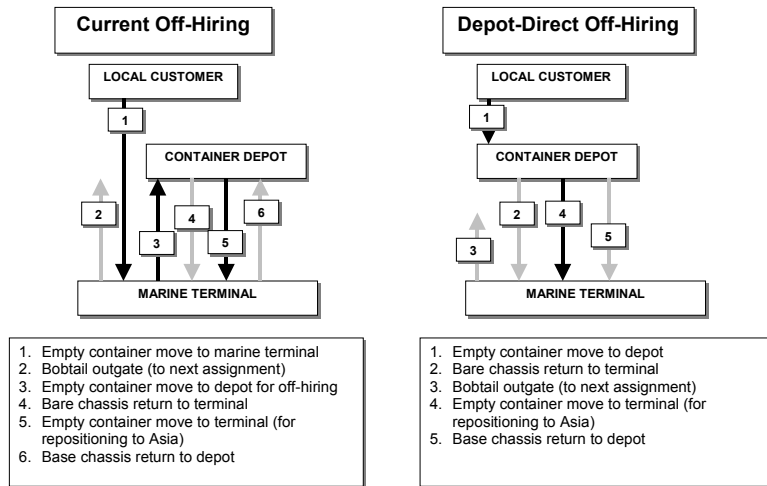
- Establish a neutral supply point for reusable empties
- Facilitate empty returns when terminal gates are closed
- Add buffer capacity to the marine terminals
- Avoid additional trips with off-hired leased boxes

In the short term the concept of off-dock empty return may have only limited application, since total cost would likely be higher than at present. Ocean carriers would incur off-dock storage costs and drayage shuttle costs, and truckers would incur detour costs. Chassis logistics may be a serious barrier. Ocean carriers often need the chassis back quickly, and if drivers have to return with the chassis they may as well return with the box too. (The depot-direct off-hiring scenario includes similar depot functions, but with the critical difference of the off-hiring step.)

The concept of off-dock empty return may have considerable *long-term* promise. In the long-term, congested marine terminals and a shift to trucker-provided chassis would make a large difference in the economics.

Potential for Depot-Direct Off-Hires

The process of off-hiring and repositioning an empty leasing company container typically requires six one-way truck trips at present, as shown below.



A process the study team has named “depot-direct” off-hiring would cut at least one truck trip from each off-hiring and repositioning cycle, making a total of five instead of six one-way truck trips. Some major ocean carriers are already investigating increased depot-direct off-hires.

Depot-direct off-hiring has considerable promise as a means of rationalizing empty container flows.

- Based on interviews, it appears that ocean carriers presently off-hire about 10% of their westbound empties, or about 180,000 total units in 2000.
- At present, draymen deliver approximately 3% of the empties directly to off-dock container depots for off-hire and storage. An estimated 3% of the intermodal empties are likewise trucked directly to depots instead of to the marine terminals.
- The rest are trucked back and forth, as shown earlier. With better information systems and changes to institutional practices, virtually all containers to be off-hired could be delivered directly to depots

The potential impact on estimated empty container flows is as follows.

- In 2000, about 54,000 empty units were off-hired directly to depots (43,555 from local import customers and 10,524 from rail intermodal terminals). About 126,184 empty units were drayed from port terminals.
- Shifting all the empties to depot-direct off-hiring would have increased that depot-direct total to about 180,000 annual units (145,184 from local import customers and 35,079 from rail intermodal terminals).
- The total truck trip savings would be equal to the number of containers affected, 126,184 in 2000, since one trip would be avoided each time.
- By 2020, the net reduction would be 510,658 annual units.

The long-term potential for depot-direct off-hiring could expand considerably if:

- Truckers or other parties begin to provide the chassis, creating flexibility in using the chassis for multiple customers and reducing chassis repositioning needs.

- Container depots and marine terminal operators cooperated to keep draymen moving with containers both ways wherever possible (e.g. draying an empty to the depot to be off-hired and returning with an empty to be repositioned)

Internet-based Systems

A major task within the study was to determine the potential for an Internet-based container information system to facilitate the interchange, reuse, return, and management of empty marine containers. In specific, it was envisioned that an Internet-based system could function as a virtual container yard. There is not yet a fully operational, well-used Internet system to facilitate empty container reuse and interchange. Existing systems, however, are moving in that direction.

All major ocean carriers and marine terminal operators have information systems in place to communicate with customers and drayage firms. Within Southern California, the best known system of this kind is Marine Terminal Corporation's **VoyagerTrack**. It is used to monitor containers, cargo status, and related activities. VoyagerTrack does not presently support or facilitate container reuse except to the extent that it gives dispatchers good information regarding container status, last free day, etc.

There have been several systems developed by ports or other organizations to provide container status information to the broader port community. The **eModal** system is a Southern California example. eModal.com currently operates an expanding container "bulletin board" system for the container shipping industry. The eModal system was developed by transportation industry professionals and has attained a high degree of acceptance in the intermodal industry. The system has recently introduced "eModal Scheduler", which provides marine terminals and trucking companies the capability to schedule pick-up and deliveries. eModal does not yet have a specific feature to support container reuse, although it reportedly has such a feature under development.

InterBox is a service provided by International Asset Systems. InterBox is an Internet-based trading system that facilitates the exchange of shipping container capacity in a secure, business-to-business environment. InterBox participants include IMCs and third parties, container leasing companies, and ocean carriers. InterBox would enable truckers to post their inventories of excess empty containers with a zero asking price, effectively becoming a virtual container yard. InterBox has not yet been used for this purpose to any great extent and it remains to be seen how well it can perform this function for local and regional motor carriers as proposed to global ocean carriers.

SynchroNet Marine offers multiple services designed to enable ocean carriers, IMCs, and others match up empty container capacity with shipment demand and move excess boxes at the lowest possible cost. SynchroNet has recently introduced **SynchroMet**, the only system introduced to date with the specific purpose of facilitating street turns and empty container reuse. SynchroMet has been introduced in the Metropolitan Bay Area with the support of the Port of Oakland.

The systems mentioned above are converging on the container reuse issue from different directions. It is likely that the industry will continue to progress towards a workable and working virtual container yard system without a need for public sector intervention.

User fees, however, are a major issue for the Internet-based systems. The economics of empty container reuse are not overwhelmingly positive, and it may be difficult for drayage firms to realize and recognize savings to offset the costs. The acceptance of user fees and the use of these systems should be carefully monitored to insure that fees do not become a barrier to increased empty reuse and depot-direct off-hiring. Should they become a barrier, public subsidy might be considered as an option.

Institutional Issues

The major barriers to rationalizing empty container movements are not technical or economic, but institutional. For the most part institutional barriers make interchange more complex, increase the management and clerical time required, increase costs, and increase liability exposure. The most prominent institutional barriers include:

- Limited free time
- Managing repair charges
- Inspection and paperwork
- Lack of a common or consistent procedure for trucker interchange
- Liability issues

The incentives for ocean carriers and truckers to reuse containers are relatively small, and faced with institutional difficulties, management demands, costs, or risks, their rational course of action will be to simply return empties and obtain other containers for export loads.

Risk Management & Legal Issues

Each party in the intermodal business currently manages their own risk exposure through a combination of legal and procedural safeguards, contractual terms and conditions, and insurance coverage.

In a virtual CY operation, a third party to the interchange transaction would establish a neutral website or other system that lists available empty international containers. Container equipment providers (e.g. ocean carriers) and motor carriers would contract with the website operator for the use of the system to dispose of excess empty equipment or to locate needed equipment for loading. Assuming that the import and the export users are authorized to interchange the equipment provider's equipment (e.g., are members of UIIA with the equipment provider's addendum current) the thorny legal issue is documenting the equipment condition and documenting agreement on responsibility for damages to the equipment. In the virtual CY environment, the website would provide a facility which records the transaction and then notifies

the equipment provider electronically requesting reauthorization of the two moves. The legal structure for this transaction could be handled by the Terms and Conditions of the website.

In a depot-direct off-hiring system, rather than returning import empties to marine terminals they are returned to off-dock depots directly after unloading. Once the import motor carrier is notified to terminate the equipment to an off-hire site, there will be an inspection and termination of the equipment. Since only one motor carrier is involved, there should be no issue as to responsibility for per diem or equipment damage. There are no particular thorny legal issues with this process.

While there are many agreements between parties covering the interchange of intermodal containers, the agreement with the widest applicability and use is the Uniform Intermodal Interchange & Facilities Access Agreement (UIIA). The UIIA's basic language anticipates that the party who is using the equipment (the trucker) will return it to the party who provided it (the ocean carrier). The UIIA provides a framework that can be relatively easily modified to add participants in order to include all necessary contracting parties and to bind them into a legally enforceable agreement. The UIIA is also positioned to handle scanning of interchange records and resolution and apportionment of equipment provider claims.

Empty Container Logistics Strategy

The goal of a regional empty container logistics strategy is to maximize the ability of the port and intermodal community to reuse empty containers for export loads and rationalize empty container returns. Any empty container logistics strategy must be effective and practical. The intermodal industry is complex but obeys one simple rule: the participants' motivation is commercial, not altruistic, and an empty container handling strategy must yield concrete financial and operational benefits to be successfully implemented.

A successful empty container logistics plan should satisfy several criteria and provide sufficient net benefits to stakeholders to create incentives for ongoing use:

- Reduce VMT for empty containers
- Reduce trips to port marine terminals, the number of empties on terminal, and empty container dwell time.
- Offer economic and operational benefits to trucking companies and other stakeholders, and net benefits to the region

The elements of an effective empty container logistics strategy will likely include:

- A role for an Internet-based information system, specified in terms of functions performed rather than system features or software specifications
- Increased reuse of empty import containers for export loads
- Increased depot-direct off-hiring

Truck Trip Impacts

The table below summarizes the combined impact of increased reuse and depot-direct off-hiring. The combined scenario, incorporating both increased reuse of empty import containers for

	2000	2010	2015	2020
Base Case	2,725,390	5,067,144	7,335,344	10,849,368
Tier I - 5% Reuse	2,638,933	4,909,453	7,103,034	10,501,376
Trips Saved	86,457	157,691	232,310	347,992
Tier II - 10% Reuse	2,494,838	4,646,635	6,715,850	9,921,389
Trips Saved	230,552	420,508	619,494	927,980
Depot-Direct 10%	2,599,206	4,841,966	6,997,993	10,338,710
Trips Saved	126,184	225,178	337,351	510,659
Combined Scenario	2,376,091	4,435,022	6,398,482	9,440,665
Trips Saved	349,299	632,122	936,862	1,408,703

exports and increased depot-direct off-hiring, would maximize the net truck trip reduction. In 2000, such a strategy would save 349,299 annual trips, or about 956 per day. By 2020, the annual total would reach 1,408,730 and the daily trip savings would average 3,859.

VMT & Emissions Impacts

In order to determine the impacts on traffic and air quality, it was necessary to convert the trips saved for each type of movement to an estimated Vehicle Miles Traveled (VMT). It was then possible to estimate emissions impacts by using standard emissions factors for typical drayage tractors.

Several data sources were used to estimate the trip length to and from various empty container points of origin and destination. The vehicle miles traveled (VMT) were then estimated by multiplying the average trip lengths by each empty container trip type. The table at right gives the annual VMT reductions for the Reuse, Depot Direct, and Combined empty container strategy scenarios.

	2000	2010	2015	2020
Base Case	34,385,909	64,040,254	92,374,112	136,322,325
Tier I - 5% Reuse	33,188,403	61,852,813	89,151,532	131,494,795
VMT Reduction	1,197,505	2,187,441	3,222,579	4,827,530
Tier II - 10% Reuse	31,192,561	58,207,077	83,780,567	123,448,912
VMT Reduction	3,193,347	5,833,177	8,593,545	12,873,414
Depot-Direct 10%	33,376,434	62,238,830	89,675,301	132,237,056
VMT Reduction	1,009,474	1,801,424	2,698,811	4,085,269
Combined Scenario	30,242,584	56,514,171	81,241,625	119,603,121
VMT Reduction	4,143,324	7,526,083	11,132,487	16,719,205

Emissions

Emissions estimates were based on the combined total empty trip type (imports, exports and cross-town) and EMFAC7F1.1 model year 2010 emissions factors for each pollutant type (carbon monoxide, organic gasses, oxides of nitrogen, and particulate). Total emissions are directly correlated to VMT for each type of pollutant. Since the emissions are correlated to the VMT reductions, the largest categories of emissions for drayage tractors – carbon monoxide and

Emissions Summary				
Scenario & Emissions Type	2000		2020	
	Annual Tons	Peak Day Tons	Annual Tons	Peak Day Tons
Base Case				
Carbon Monoxide	497	2.14	1,970	8.48
Total Organic Gases	113	0.49	449	1.93
Reactive Organic Gases	111	0.48	438	1.89
Oxides of Nitrogen	420	1.81	1,666	7.17
Exhaust Particulates	39	0.17	155	0.67
Combined Scenario				
Carbon Monoxide	437	1.88	1,728	7.44
Reduction	60	0.26	242	1.04
Total Organic Gases	100	0.43	394	1.70
Reduction	14	0.06	55	0.24
Reactive Organic Gases	97	0.42	385	1.66
Reduction	13	0.06	54	0.23
Oxides of Nitrogen	370	1.59	1,462	6.29
Reduction	51	0.22	204	0.88
Exhaust Particulates	34	0.15	136	0.58
Reduction	5	0.02	19	0.08

oxides of nitrogen – show the largest reductions. The table at left summarizes the estimated emissions impacts for Base Case and Combined Scenario.

Benefit-Cost Tradeoffs

The net public benefits of improved empty container logistics are significant reductions in regional truck VMT and emissions. Direct public-sector costs, if any, are likely to be minor.

The *net* private sector benefits are likely to be significant as well, encompassing reduced drayage trips, better equipment supply and control, reduced terminal gate costs, etc. The measurable net benefits to any one party, however, may be slim, and hard to measure. The success of an empty container logistics strategy depends on the balance of incentives.

Virtual CY. The benefits of a virtual container yard would be widespread, although difficult for any one party to estimate in advance with precision. The physical operating costs would fall primarily on truckers, while managerial and clerical costs would be shared.

Empty Reuse. The private sector benefits and costs of increasing empty container reuse, whether through a virtual CY or existing means, include reduced drayage trips and improved equipment supply. Empty returns are a cost factor for the driver and drayage firm, and must be covered by the revenue from the loaded trip leg. There would be slightly more than three one-way trips avoided for every container reused (including reduced bobtail outgates at the marine terminals, and at least one additional cross-town trip, for a net reduction of two trips).

- The primary direct beneficiary of increased reuse may be the **owner-operator/driver**. To the extent that empty and bobtail moves will be avoided, the owner-operator's cost will be reduced while revenue remains unchanged. Reducing the need for non-revenue moves would also increase the driver's productivity and earning power. Benefits to the **drayage firm** would include increased driver productivity and revenue potential, improved customer relations and retention, and reduced upward cost pressure.
- **Ocean carriers** would benefit from increased container productivity, reduced gate transaction cost, reduced on-terminal empty container inventory and storage, and improved customer relations. Ocean carriers, like drayage firms, would experience some additional overhead cost to support the street turn process. Benefits to **customers** (shippers and consignees) would be less tangible, and would consist primarily of improved empty equipment supply and reduced upward pressure on long-term drayage rates for loaded moves.

The key trade-off rests with the drayage firms, since they will have to take the initiative to locate and exploit reuse opportunities.

Depot-Direct Off-Hiring. As with empty container reuse, the cost/benefit tradeoff for depot-direct off-hires rests primarily on the **drayage firm**. Under existing practices truckers would only benefit if compensated for detours to depots, since they would incur additional driving and terminal time. Truckers may not be willing to participate if non-revenue depot-direct off-hires divert drivers in peak periods, when driver productivity is critical to handle revenue moves. Appropriate trucker compensation could be weighed against savings to ocean carriers or leasing companies from additional drays and reduced empty storage costs. **Ocean carriers** would incur management costs for additional planning, and incur information systems costs. Ocean carriers would, however, benefit from expedited off-hires, from reduced total drayage moves and expense, from reduced gate charges, and reduced storage costs.

Container Depot Capacity

The study team sees a limited but important future role for public agencies in planning for adequate container depot capacity and access. Container depots find it difficult to increase their capacity and capabilities, and may not be able to support the full development of off-dock depot and off-hiring functions under present conditions. Container depot capacity may thus be the only significant public planning need in an empty container logistics strategy:

On-Going Research Needs

While the outlines of a short-term logistics strategy are clear, there remain numerous unanswered detail questions and points where estimates have been made in the absence of solid data. As the marine intermodal industry moves toward additional reuse flexibility, depot-direct off-hire, and the use of Internet-based systems, both private and public interests would be served by additional research into some of the issues below:

- Off-dock container depot storage and land requirements
- Westbound domestic backhaul container loads and logistics
- Off-hiring movements and logistics

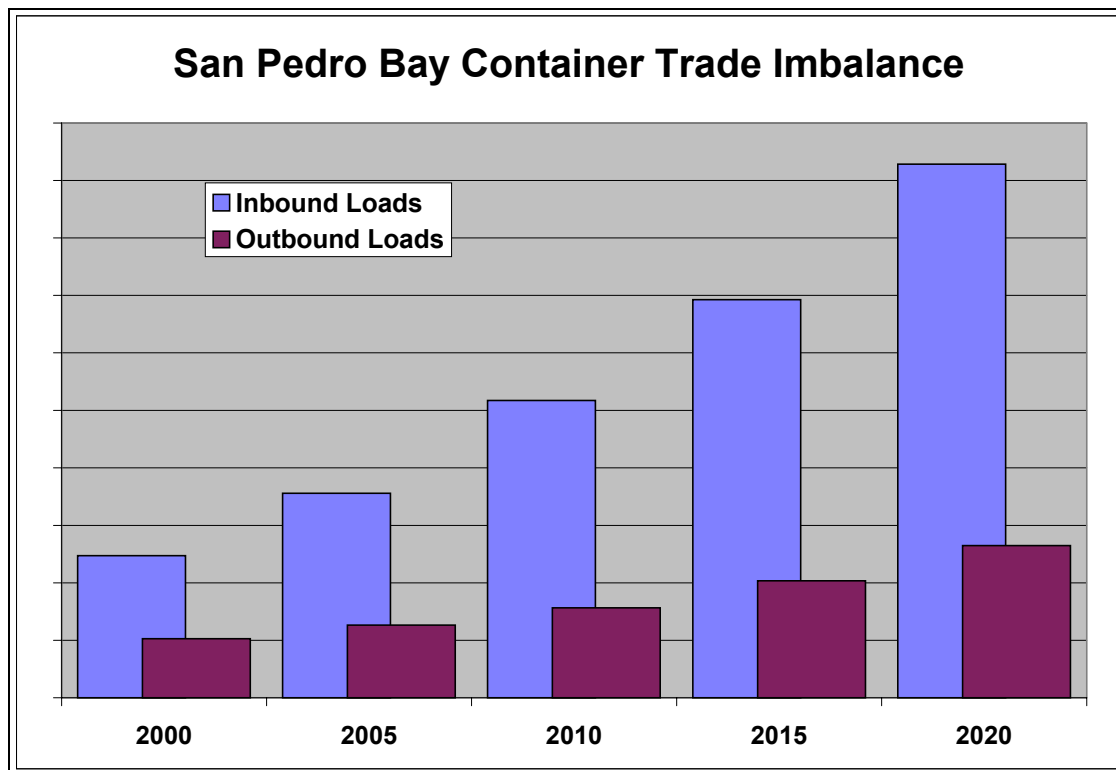
II. Background & Approach

Background

In a perfectly balanced trading environment, every import container arriving on the West Coast would be filled with an outbound load. While that precise balance has never been achieved, for much of the last decade that balance was close enough for ocean carriers and others in the industry to consider empty container logistics a nuisance rather than a major problem. When the volume of empty containers remains manageable, it is merely an operational cost that must be accommodated in the industry.

Current containerized trade through San Pedro Bay, however, is severely imbalanced, and the imbalance is expected to worsen, as shown below. The difference between rapidly growing eastbound imports and slowly growing westbound exports since 1996 has left the U.S. and the West Coast with a massive and increasing container imbalance (Exhibit 1). The dramatic imbalance in transpacific trade has markedly increased empty container flows and created a significant empty container problem.

Exhibit 1
Container Trade Imbalance

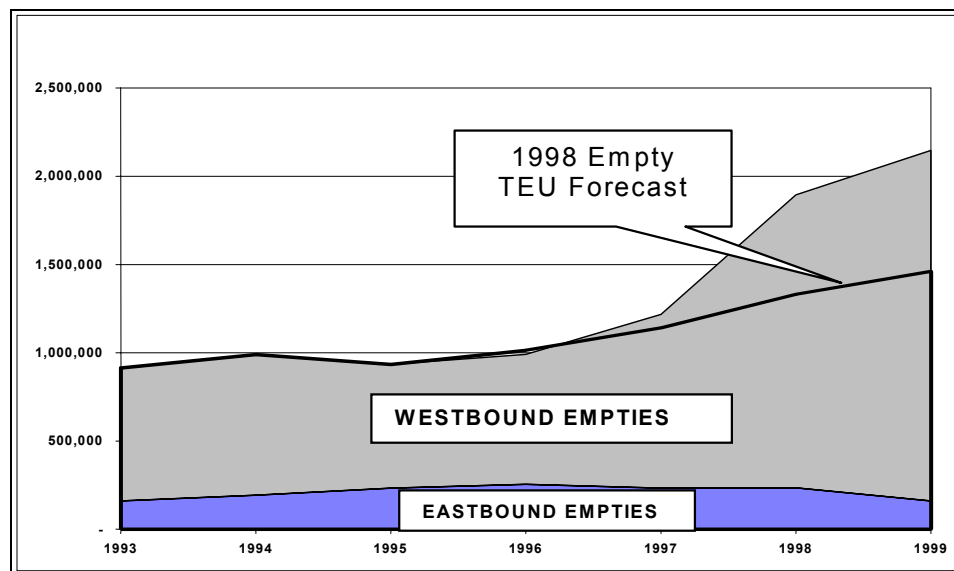


As the leading port region, Southern California has naturally felt the greatest impact. The problem is exacerbated by the sheer volume of containers moving through a major urban area that already has serious traffic congestion and air quality concerns.

The outbound flow of empties through San Pedro Bay has been further augmented by an influx of westbound double-stack trains that chiefly carry empties diverted from their former Northern California and Pacific Northwest destinations. The ocean carriers have diverted the trains, and the empty containers they carry, to insure an adequate eastbound rail car supply in Southern California. Thus far, the changes in ocean carrier empty logistics have persisted.

The unprecedented flow of empty containers through the Ports of Long Beach and Los Angeles has far exceeded the existing forecast. (Exhibit 2)

Exhibit 2
Empty Container Forecasts and Flows



Drayage firms are making more empty container moves back to the port. Empty containers have a longer dwell time in marine terminals and are using up scarce terminal capacity. Container depot operators who store empties are restrained by local ordinances from increasing capacity by stacking higher.

The Gateway Cities lie directly in the path of most of these empty container movements. Within or adjacent to the Gateway Cities are numerous import distribution centers and transloading facilities, and three major rail intermodal yards that generate a continuous stream of empty movements to the Ports. Interstate 710 bears the brunt of this traffic, but other major freeways and arterials are affected as well. An increase in transloading activity (transferring the contents of a marine container to a domestic vehicle for onward delivery) has brought more container traffic to the Gateway Cities and more complexity to the entire empty container problem.

Empty containers move both to and from the ports. Once emptied, the containers used for import loads are typically drayed back to marine terminals. Exporters draw a supply of empty container from the terminals, returning loaded boxes the other way. Reusing empty import containers for the export loads is an intuitively attractive idea, as it could reduce this apparently wasteful movement of empties in both directions. As this report reveals, however, empty container reuse and related opportunities are tremendously complex notions with practical limitations.

The opportunities for reusing or interchanging empty containers under current institutional constraints are too few to make an appreciable impact on the volume of empty moves. “Street turns” — reusing import containers for export loads without first returning them to the marine terminal — are regarded by all parties as highly desirable, but hard to achieve.

Yet the potential benefits are clear:

- The drayman (driver) saves truck trips to and from the port, and hours of time.
- The drayage firm and the drayman both generate more revenue in less time.
- The ocean carrier saves paperwork and may have the container turned quicker.
- The export customer gets the right container sooner.
- Traffic, congestion, noise, and emissions are reduced.

Information systems promise to increase street turns by assisting drayage firms to identify import/export linkages and quickly locate suitable containers for export loads. In the absence of significant changes to the operating environment, however, the broader institutional issues are likely to limit the ability of drayage firms to reuse empty containers. Information involving the business of shippers and receivers is by nature proprietary, and both ocean carriers and drayage firms are reluctant to share information on their customers. Moreover, the requisite information is divided up among numerous parties, even for relatively simple transactions.

This study is intended to help the Ports, the Gateway Cities, and the SCAG region break through those barriers. The development and eventual implementation of a practical, effective empty container logistics strategy driven by an Internet-based information system has significant potential to ameliorate the serious empty container problem facing Southern California.

Project Objectives

The following study objectives are implicit in the RFP and in the Tioga team’s understanding of the project:

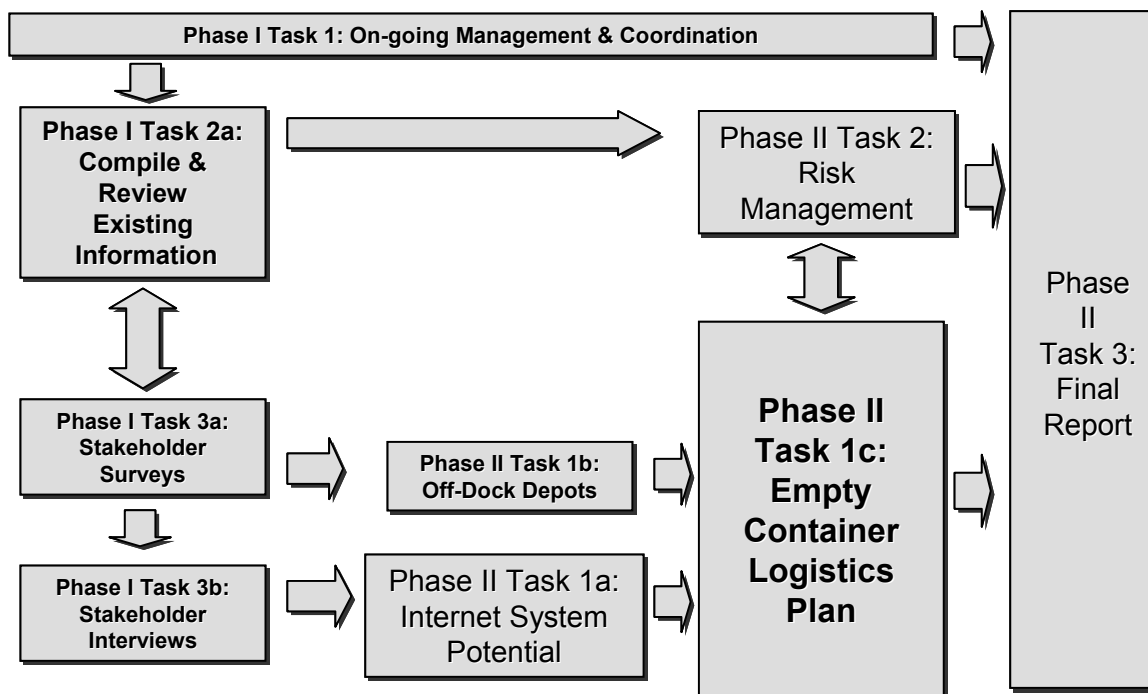
- Understand and document the current and projected flows of empty ocean containers in the study area
- Contact and interview industry participants to define empty container logistics practices, limitations, and potential for improvement
- Investigate the use of an Internet-based information system to assist motor carriers, ocean carriers, and other participants to interchange empty containers and support off-dock empty returns
- Describe an empty container logistics strategy
- Determine the legal, procedural, insurance, and other institutional requirements of an empty container logistics strategy.

Approach

The Tioga Group (Tioga) served as the prime contractor throughout, leading each task and with principal responsibility for communications, scheduling, and deliverables. Meyer, Mohaddes Associates (MMA) made critical contributions in identifying empty container flows, estimating VMT changes, and formulating an empty container logistic strategy. Integrated Intermodal Services, Inc. assisted with institutional and legal issues.

The flow chart below shows the major project tasks undertaken and their relationships.

Exhibit 3
Project Flow Chart

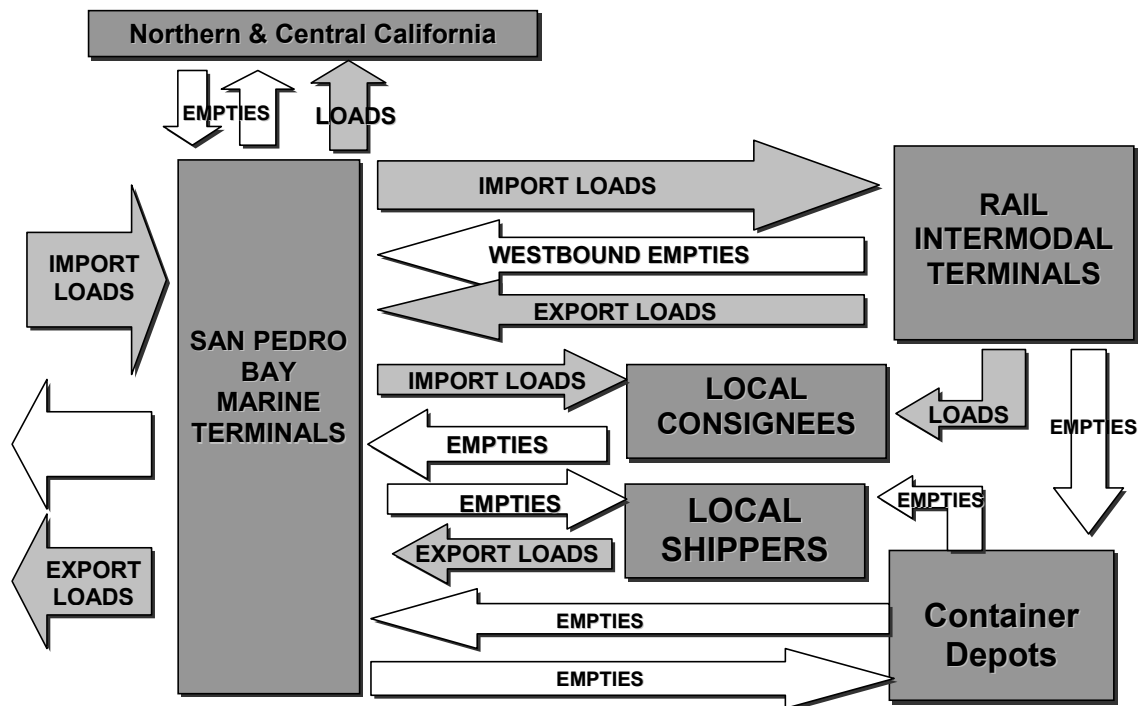


III. Empty Container Flows

Empty Container Flow Estimates

As Exhibit 4 illustrates, there is not just one empty container flow, but a number of individual flows.

Exhibit 4
Complex Empty Container Flows



Although the total number of empty containers moving through the SCAG region is documented, individual flow components must be estimated. The vast majority of past data collection and compilation efforts have focused on loaded container movements, since in most cases it is loaded containers that constitute actual trade, generate revenue, and demand efficient service. In many cases the flows of empty containers must be inferred from the more complete records of loaded movements. The 1998 San Pedro Bay Long-Term Cargo Forecast is an exception, being one of the first efforts to forecast the flows of empty containers. Likewise, the trucker and terminal data collection components of the Port of Long Beach Transportation Master Plan address empty movements directly rather than by inference.

The approach taken in this study combines data from the Long-Term Cargo Forecast and the Transportation Master Plan with results from ocean carrier, trucker, and other stakeholder interviews. Elements of the estimates are necessarily judgmental since there is no comprehensive data source and the informal estimates of stakeholders cannot be assembled into a rigorous statistical analysis or database.

Exhibit 6 displays study team estimates of the various empty container flows shown graphically in Exhibit 4. The table shown is part of a spreadsheet model constructed to link the flows together and permit estimates of scenario impacts.

Eastbound Flows

The study team has estimated that in the year 2000 about 1.3 million empty twenty-foot units (TEU), or 716,000 empty containers (at 1.85 TEU/unit) moved eastbound from the marine terminals to local or regional inland destinations. Eastbound flows have three components (Exhibit 5):

- There is a *comparatively* minor flow of oceanborne empty containers entering the ports eastbound for intermodal movement and loading inland, about 40,000 annual units. Despite the overall imbalance, empty containers may move eastbound to provide the proper mix of container types or to serve the needs of individual carriers and customers within the overall trade flow. This category was estimated using data from the port cargo forecast and is split between on-dock intermodal (30%, about 12,000 units) and off-dock intermodal (70%, about 28,000 units), with the later share moving by truck to the rail terminals.
- The flow of empty containers from marine terminals to regional exporters for loading is much larger. This number, about 550,000 annual units, was estimated by taking the port cargo forecast for locally generated exports and subtracting the portion of capacity thought to be provided by reusing import boxes (discussed below). This flow accounts for about 77% of the empties leaving the ports eastbound.
- There is a *relatively* small flow of steamship line (SSL) leased empties being drayed for off-hiring at local depots. The study team estimated from interview results that about 10% of the ocean carrier empties are off-hired, or 180,000 annual units. About 70% of the off-hires (7% of the total, or 126,000 units) are trucked from the marine terminals while 30% (3% of the total, about 43,500 units) are drayed cross-town directly from consignees (as shown at the bottom of the table).

Exhibit 5
Eastbound Empty Container Flows

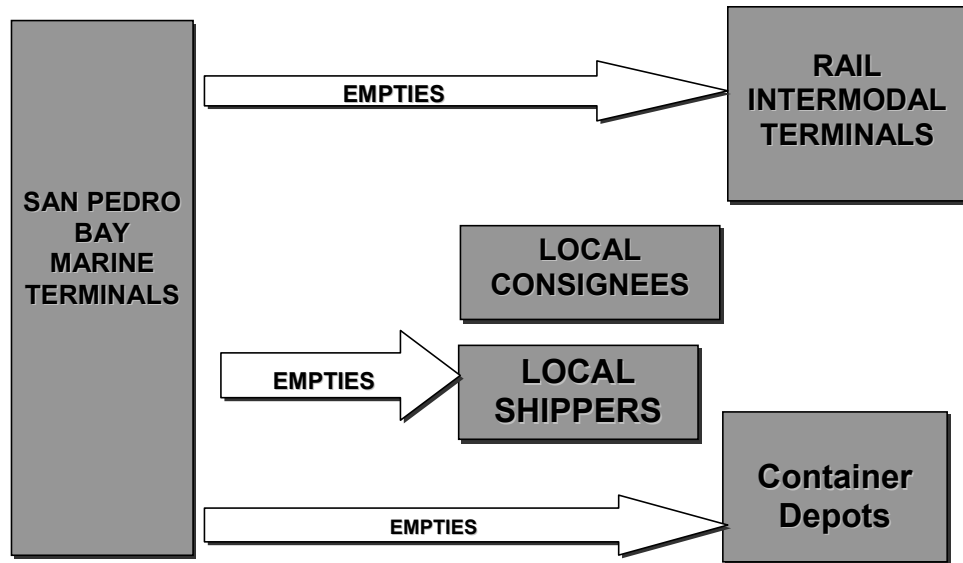


Exhibit 6
Base Case Empty Flow Estimates

	2000		2010		2015		2020	
	TEU	Units	TEU	Units	TEU	Units	TEU	Units
Port Inbound/Eastbound	1,324,476	715,933	2,738,344	1,480,186	3,631,065	1,962,738	5,027,971	2,717,822
Via Rail	22,169	11,983	80,413	43,467	116,400	62,919	170,494	92,159
On-Dock Intermodal	22,169	11,983	80,413	43,467	116,400	62,919	170,494	92,159
Via Truck	1,302,306	703,949	2,657,931	1,436,719	3,514,665	1,899,819	4,857,476	2,625,663
Off-Dock Intermodal	51,728	27,961	187,631	101,422	271,600	146,811	397,820	215,038
Local for Export Loading	1,017,137	549,804	2,053,720	1,110,119	2,618,965	1,415,657	3,514,937	1,899,966
SSL Off-Hires to Depots	233,441	126,184	416,579	225,178	624,100	337,351	944,719	510,659
Port Outbound/Westbound	3,568,312	1,928,817	6,367,713	3,442,007	9,539,815	5,156,657	14,440,698	7,805,783
Via Rail	278,128	150,339	501,602	271,136	731,291	395,293	1,084,536	586,236
On-Dock Intermodal	278,128	150,339	501,602	271,136	731,291	395,293	1,084,536	586,236
Via Truck	3,290,183	1,778,478	5,866,112	3,170,871	8,808,524	4,761,364	13,356,161	7,219,547
Off-Dock Intermodal	564,600	305,189	920,401	497,514	1,491,797	806,377	2,366,438	1,279,156
Local from Import Loads	2,084,712	1,126,871	3,842,221	2,076,876	5,661,030	3,060,016	8,483,038	4,585,426
Local from WB Domestic Loads	64,897	35,079	105,793	57,186	171,471	92,687	272,004	147,029
Repo Off-Hires from Depots	333,487	180,263	595,113	321,683	891,572	481,931	1,349,598	729,512
Local Empties from Transloads	242,488	131,075	402,583	217,613	592,655	320,354	885,083	478,423
Bobtail Trip Change		0		0		0		0
Port Subtotal	4,892,787	2,644,750	9,106,058	4,922,193	13,170,880	7,119,395	19,468,669	10,523,605
On-dock rail	300,297	162,323	582,015	314,603	847,691	458,211	1,255,031	678,395
Truck through Terminal Gates	4,592,490	2,482,427	8,524,043	4,607,591	12,323,189	6,661,183	18,213,638	9,845,210
Cross-Town Truck Factor	149,184	80,640	268,159	144,951	399,506	215,949	602,663	325,764
Local Off-Hires to Depots 3%	80,577	43,555	146,796	79,349	216,030	116,773	323,278	174,745
IM Off-Hires to Depots 3%	19,469	10,524	31,738	17,156	51,441	27,806	81,601	44,109
Reused empties for exports 2%	49,138	26,561	89,624	48,446	132,035	71,370	197,784	106,910
Grand Total	5,041,972	2,725,390	9,374,216	5,067,144	13,570,387	7,335,344	20,071,332	10,849,368

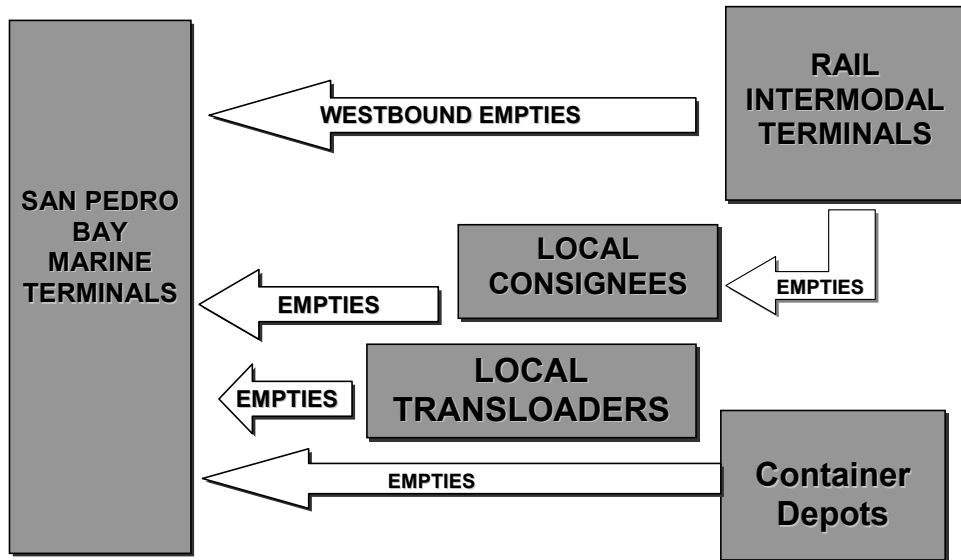
Westbound empty flows

Since transpacific imports to the U.S. greatly exceed the U.S. exports to Asia, the vast majority of empty containers move westbound back to Asia for reloading. The westbound flow includes five major components (Exhibit 7), most of which are analogous to their eastbound counterparts.

- There is a large intermodal flow of oceanborne empty containers returning westbound from inland consignees. This consisted of about 501,000 units in 2000, or about one-fourth of the westbound total. This flow was estimated using data from the port cargo forecast and is split between on-dock (30%) and off-dock (70%) intermodal (consistent with the port transportation study), with the later share moving by truck from the rail terminals to the marine container terminals.
- There are no reliable data on westbound marine containers that are loaded with domestic “backhaul” goods. The study team has allowed for 10% of the westbound empties (35,000 units) to be used in this way, but there is no method by which a more accurate estimate can be made within the confines of this study.
- The flow of empty containers from import consignees back to marine terminals is a major focus of this study. This flow was estimated at about 1.1 million units in 2000, 58% of the westbound total. This number was estimated by taking the port cargo forecast for local imports and subtracting the portion of local capacity thought to be reused for export loads (discussed below).
- There is a relatively small flow of leasing company empties being drayed from local depots for subsequent repositioning, about 180,000 units in 2000. This figure is the same as the estimate for the total containers being drayed from marine and rail terminals for off-hiring. While the same number of containers will eventually return to balance the system, they may not be the same containers and may not return to the same marine terminals.
- Local empties from transloads were estimated from port and consultant studies of the transloading business at about 131,000 units in 2000. This is treated as a separate flow to maintain the conceptual distinction and to allow for shifts in the transloading share. If these containers were not transloaded they would move inland intact to more distant points.

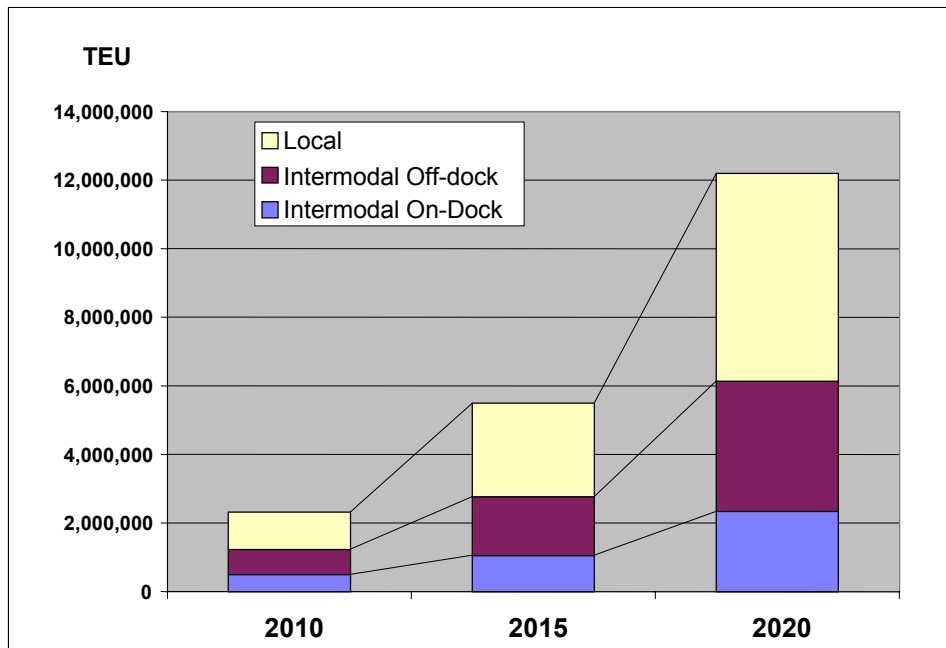
There is an entry for westbound “Bobtail Trip Change” in this exhibit and subsequent similar tables. About half the time, a tractor that arrives at a marine terminal (for any reason) leaves “bobtail”, without either chassis or container. Reuse and off-hiring scenarios that reduce the number of tractor trips to marine terminals will also reduce the need for bobtail outgate moves *in the same number*. Although an average of half the outgate moves are bobtail now, the reduction in moves will come from the unproductive bobtails rather than from revenue trips.

Exhibit 7
Westbound Empty Flows



While the expansion of on-dock rail transfer and the operation of the Alameda Corridor are both expected to increase the volume of containers handled by rail and relieve what would otherwise be intolerable pressure on the regional highway network, the relief will be limited. Growth across all categories — intermodal on-dock, intermodal off-dock, and local — means that the vast majority of empty westbound containers will still be trucked to the ports. (Exhibit 8)

Exhibit 8
Westbound Empty Container Flows by Mode

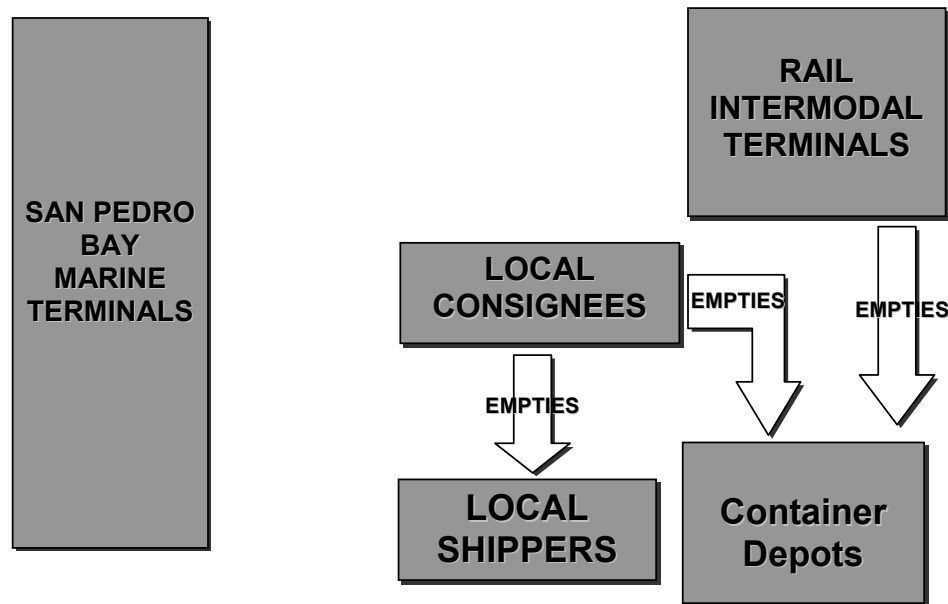


Cross-town (non-port) empty flows

Non-port “cross-town” empty flows (Exhibit 9) are those that do not either originate or end at port terminals. They include three components:

- Local “depot-direct” off-hires of leasing company containers are sometimes drayed to off-dock depots. Based on interviews, the study team has estimated that about 10% of the westbound empties are off-hired and that 30% of these (3% of the total, or about 43,500 units in 2000) are moved directly to depots rather than back through the marine terminals. One goal of the empty container logistics strategy will be to increase this percentage.
- Some empties arriving westbound by rail are also off-hired directly to depots. The study team has estimated the same share (3%) for both local and intermodal depot-direct off-hiring, or about 10,500 units in 2000.
- Based on interviews, the team estimates that at present some 2% of the empties generated by local import loads are reused for local exports instead of being off-hired or returned to marine container terminals, about 26,500 units in 2000. Increasing this factor is another goal of the empty container logistics strategy.

***Exhibit 9
Cross-Town Empty Flows***



Outlook

The table in Exhibit 6 also applies the estimated shares and relationships to the cargo forecasts for 2010, 2015, and 2020. Based on these estimates and forecasts, the number of empty containers moving through the SCAG region will roughly quadruple between 2000 and 2020. The number of empties grows faster than overall trade because of the growing imbalance.

IV. Empty Container Logistics

Service, Capacity, and Cost Control

Any discussion of empty ocean container logistics must begin with an understanding of the fundamental ocean carrier and customer needs and motivations: service, capacity, and cost control.

Ocean carriers see equipment supply as a necessary means of securing cargo for the vessel. Customers must be supplied with the right container at the right time and place — service and capacity — or they will quickly take their cargo elsewhere. Ocean carriers therefore attempt to assure that there are enough empty containers available within the regional to “protect” the expected and desired export business. As a later section explains in more detail, not all export business is equally desired, and ocean carriers will naturally give priority to their larger and more profitable accounts. Moreover, import cargo flows are much larger and more profitable than export flows, so carriers must also insure a steady flow of empty capacity to Asia for reloading with imports, especially during the peak late summer/early fall shipping season. This practice, called repositioning, currently accounts for about half of all the outbound container movements.

Ocean carriers incur four kinds of cost in maintaining container equipment service and capacity:

- **Equipment cost**, whether leased or owned, and including repairs and maintenance. The size of the container and chassis fleet, and thus its cost, is determined by the volume of traffic to be handled and the equipment “velocity” (the number of trips that each container or chassis can handle in a year). By “turning” equipment faster the carrier can minimize fleet size and expense.
- **Storage cost**, including the cost of maintaining on-dock terminal storage capacity and outside, off-dock depot storage. With the peaks, valleys, and surges of the shipping season some storage is inevitable, but a container sitting still costs money to store and earns no revenue.
- **Movement cost**, including vessel operations, drayage, and rail shipment.
- **Management and administrative cost**, including executive and clerical time, management information systems, legal fees, etc., is often neglected in a cost analysis but looms large when companies have cut staff in an attempt to stay “lean and mean.”

As expected, ocean carriers and other parties in the container business and logistics chain attempt to minimize the total cost of maintaining the desired level of service and capacity. Tracking and understanding the total cost, however, is not an easy task when there are multiple tradeoffs and complex divisions of operating authority and budget responsibility. The fragmentation of the intermodal industry, discussed below, also contributes to the difficulty of minimizing total system cost across company boundaries.

Interchange

Of the many possible transactions in the container logistics chain the most fundamental is interchange, the transfer of a container (and usually a chassis) from the responsibility of one party to the responsibility of another. Interchange is the defining characteristic of intermodal transportation. Although some ocean carriers have trucking subsidiaries, the interchange process is still necessary for transfers of equipment between them.

The interchange process has three basic parts:

- Inspection and documentation of equipment condition. This is usually the responsibility of the party receiving the equipment, since that party will later be held responsible for any damage and repair cost.
- Transfer and acceptance of liability for the equipment, its load (if any), and the terms and conditions of interchange.
- Entry of the pertinent information into the information and accounting systems of both parties.

There are three types of interchange at stake in this study. In order of decreasing frequency they are:

- **Interchanges between ocean carriers and motor carriers.** This interchange usually takes place at the marine terminal gate and container yard, with the marine terminal operator acting on behalf of the ocean carrier.
- **Interchanges between motor carriers and depot operators.** These take place when a leased or owned container is being taken on hire (“on-hired”), returned to the leasing company (“off-hired”), stored, or taken from storage at an off-dock depot.
- **Interchanges between motor carriers.** Also known as “street interchanges,” these are uncommon but not unknown, and are a principal focus of the empty ocean container logistics strategy.

There are also interchanges between ocean carriers and railroads at on-dock rail terminals and between motor carriers and railroads at off-dock rail terminals, but these are not at issue in this study.

Free time and per diem

When a motor carrier receives a container in interchange from an ocean carrier the trucker normally has five business days of “free time” in which to return the container. If the trucker keeps the container beyond the free time allowance, the ocean carrier will charge a per diem fee for each extra day, usually \$44 per day.

The ocean carrier allows the five days as a reasonable time for the trucker to delivery the container to the consignee and return it to the marine terminal after it is emptied. Since the ocean carrier wants the container back promptly for reloading with exports or repositioning overseas, it charges the \$44 per day for “excess” time. This fee was formerly around \$10 per day but was raised in 1998 when containers were in tight supply.

As discussed throughout this report, the five day allowance is probably too tight to permit widespread reuse of empty import containers for export loads. To encourage reuse there would have to be a routine process for restarting or extending the free time allowance.

Chassis Logistics

To move over the highway a container must be mounted on a chassis, a specialized trailer with fittings for secure attachment of the box. The chassis is more complicated, more expensive to purchase, and more costly to maintain and repair than the container itself. Chassis logistics are a major limiting factor in empty container logistics.

Because the chassis is more expensive than the container, ocean carriers try very hard to minimize the chassis fleet and maximize its productivity. Even when an ocean carrier has no immediate need for a specific empty container to be returned, it may have a pressing need for the chassis to come back for another movement.

In every other country the chassis is provided by the motor carrier, the customer, or a third party. In the United States the ocean carriers provide the chassis, either directly or through a pooling arrangement. Ocean carriers consider the provision of chassis in the United States to be a major extra cost and management burden that they must bear to do business here.

On-Hiring and Off-hiring

Roughly half of all containers in the world fleet are owned by leasing companies. These containers are leased to ocean carriers under “master lease” arrangements that spell out rates, the number of containers to be leased, and procedures for “on-hiring” (leasing more containers) and “off-hiring” (returning containers not currently needed). The provisions are complex, covering the number of containers that can be off-hired in various locations around the world and the “drop-off” charges that apply.

Ocean carriers are constantly fine-tuning their leased fleets by off-hiring containers in locations with surpluses and on-hiring in areas of shortage. In parallel, the leasing companies are constantly repositioning containers from areas of surplus (where they are being off-hired) to areas of demand (where they are being on-hired).

According to interview results, about 10% of the westbound empty containers are being off-hired in Southern California. Ordinarily, ocean carriers examine their Southern California container inventory at the marine terminals and dray excess containers to off-dock leasing company depots to be off-hired. This procedure accounts for an estimated 70% of the off-hiring. The other option is for the motor carrier who would otherwise return an empty leased container to the marine

terminal to take it directly to the off-dock depot instead. The “depot-direct” off-hiring accounts for the other 30%, and increasing that share is a major objective of the proposed empty container logistics strategy.

CYs and Depots

Containers are stored, maintained, and interchanged at two principal locations: the marine terminal container yards (CYs), and the off-dock container depots. The marine terminal CYs are part of the port terminal complex and operated by the marine terminal operators on behalf of the ocean carriers. Container depots are usually owned and operated by separate, specialized firms.

Existing off-dock container depots already handle large numbers of empty containers. Many empty containers are already stored off-dock in container depots operated by Container-Care, Global Intermodal Services, Shippers’ Transport, FastLane, and other firms. These depots handle both carrier-owned containers and leasing company containers, and have the capability of accepting containers from one trucker and releasing them to another. *Thus, the existing depot network already has some of the critical capabilities of the off-dock empty depots discussed in the RFP for this study.*

Multiple stakeholders

This study focuses on the interchange transaction between ocean carriers and motor carriers, and on the on-hire/off-hire transaction between ocean carriers, motor carriers, and leasing companies. Yet there exist many variations of the basic transactions and several parties may become involved. Moreover, the interests of all these parties will be affected by any empty container rationalization or logistics strategy.

Industry fragmentation and practices affect the movements of empty containers and the awareness of potential matching loads. There can be so many parties involved in any one load, and so many in the intermodal industry as a whole, that complexity is unavoidable. An effective solution must recognize and accommodate the fragmented industry structure and the use of diverse processes by the participants.

The following stakeholders participate in the container logistics chain in some fashion.

- **Container owner** — a leasing company or ocean carrier
- **Chassis owner** — a leasing company, ocean carrier, or pool operator. A very few drayage firms own specialized chassis (e.g. three-axle chassis for heavy loads)
- **Ocean carrier** — a steamship line that operates container ships and controls much of the container logistics chain. The ocean carrier may own or lease the container and is ordinarily the “Equipment Provider” for the transaction.
- **Motor carrier** — a drayage or cartage firm that takes responsibility for picking up and delivering containers on chassis

- **Driver/contractor** — The vast majority of truck drivers in the drayage industry are independent contractors who own the tractors they drive, with only a few being employees of the drayage companies. Independent contractors are ordinarily paid a share of the drayage fee, usually about 70%. They are paid by the loaded move, not by the mile or the hour, and are usually not paid separately for moving empties. Empties are returned as part of the loaded movement assignment.
- **Marine terminal operator/stevedore** — These firms operate port terminals on behalf of ocean carrier clients. There may be one or several carriers calling at a given terminal. Marine terminal operators/stevedores hire longshoremen (ILWU members) by the shift. The terminal operator may be an independent firm such as Stevedoring Services of America (SSA) or Marine Terminals Corporation (MTC), or a subsidiary of an ocean carrier such as Eagle Marine (APL) or Maersk Pacific (Maersk Sealand).
- **Container depot operator** — Firms such as Containercare, Global Intermodal Services, and FastLane operate container depots where containers are stored and repaired.
- **Container repair company** — Container repair services can be offered by marine terminal operators, container depot operators, or independent contractors in any location.
- **Container surveyors** — These firms specialize in inspecting marine containers for condition and damage when the containers are on-hired, off-hired, or received in damaged condition.
- **Shipper** — The shipper is ordinarily the party who has loaded the container with goods. Depending on the financial arrangements, the goods in transit may belong to either the shipper or the consignee, and the party who actually owns the goods is called the “beneficial owner.” A shipper could be a third party (e.g. forwarder or consolidator) who has consolidated multiple shipments or loaded the container on someone else’s behalf.
- **Consignee** — Also called the receiver, the consignee is the party who is receiving the goods, whether or not they own the goods at that point. A consignee might be a third party or consolidator.
- **Third parties** — The “third party” nomenclature covers a broad array of potential participants who are neither carriers nor shippers/consignees. Third parties include Customs brokers, consolidators, ocean freight forwarders, transloaders, and non-vessel operating common carriers (NVOCCs). Third parties may load and unload containers and arrange for ocean, highway, or rail transportation.
- **Longshoremen** — Longshoremen are members of the International Longshore Workers Union (ILWU) and are ordinarily hired by the shift from a central hiring

hall. Longshoremen include the clerks who man the terminal gates, inspect equipment, and process the interchange documents.

Although not explicitly addressed in this study, the railroads and their terminal operations contractors also participate in the empty container logistics chain.

Fortunately, development of an empty container logistics strategy for the region need not explicitly consider the interests of all these parties. In discussion with the ocean carriers and truckers, the study team determined that:

- Only a small percentage of empty containers would be reusable under even the best circumstances, so there would always be an adequate supply of empties for reuse without attempting to handle the more complex transactions
- The incentives for reusing containers or off-hiring them directly are small, and none of the parties mentioned above would be likely to cope with more complex transactions and multiple parties for such a small return.

Thus, any empty container logistics strategy to promote reuse and off-dock handling should address the relatively simple transactions involved in most cases and not attempt to accommodate all the more complicated cases.

V. Virtual Container Yard Concept

Definition & Purpose

The container yard or “CY” is the portion of a marine container terminal (or off-dock depot) used for staging, sorting, storing, and exchanging containers — a parking lot, with additional functions. Loaded containers wait there to be picked up and empty containers are returned there for storage, reuse, or repositioning. Much of the work done at the CY or at the gates that mark its boundaries is the paperwork or electronic equivalent for the interchange process:

- Incoming inspection by the equipment owner or representative, or outgoing inspection by the motor carrier.
- Completion of interchange documents verifying that responsibility for the container, chassis, and load (if any) has shifted from one party to the other.

A container yard or “CY” is a physical location, and at the heart of the empty container logistics issue are the numerous trips required to move containers back and forth. Containers move back and forth because at present there is no alternative.

A conceptual alternative to the physical container yard has come to be known as a “virtual container yard” (or “virtual CY”). The truck scheduling and dispatch system originally described in the Request for Proposals for this project had at its core information on the availability and status of containers at the port and in the study area. The notion of a computer “clearing house” or “bulletin board” for information on the status and availability of containers at marine terminals has been investigated in several instances, and the “virtual CY” nomenclature has come to cover a range of possible approaches.

The objective of a virtual CY is to allow some or all of the CY functions to take place without moving the container to the physical CY. The key purposes of a virtual CY are to:

- post needed information about containers (status, location, etc.)
- facilitate communication between parties (motor carriers, ocean carriers, leasing companies, chassis pool operators)
- permit equipment interchange and other processes to take place without moving the container to the harbor
- assist the parties to make optimal decisions regarding container logistics (return, reuse, interchange, etc.), rationalize moves, and plan ahead

The virtual container yard would not be a “dispatching system.” Trucking firms are interested in more information to use in dispatching, but are unlikely to turn over actual dispatching control to another party. Dispatching — assigning drivers and trucks to specific trips — is a critical function in a trucking company, and a major element in equipment and driver utilization. While

computer-aided dispatching systems exist, they are usually intended for large LTL or truckload firms. A virtual container yard as contemplated in this report would give the dispatcher better information on which to act, but would not be a dispatching system per se.

Virtual CY System Requirements

The technical demands of a virtual CY are modest. Since its major functions are to allow posting of critical information and serve as a conduit for communication, its fundamental requirements can be addressed in those two aspects

Information needs

The virtual CY would facilitate good decision making, not dispatch trucks or attempt to match containers with uses. One information system could serve both reuse and off-hire needs with the same information, as indicated in the table below. Note that although the content would differ, the same basic information types are needed for both container and chassis.

Exhibit 10
Virtual CY Information Requirements

<i>Info Source</i>	<i>Container Info</i>	<i>Chassis Info</i>
Ocean Carrier	Box Serial No.	Chassis Serial No.
	Box Type & Specs	Chassis Type
	Reuse Limits	Reuse Limits
	Return Location	Return Location
	Free Time/Per Diem	Free Time/Per Diem
Trucker	Location	Location
	Time/Date Available	Time/Date Available

The information shown above would not tell a drayman where to locate an export reuse opportunity, but would simply assist the drayman to exploit opportunities the drayman has already located. Attempting to match a specific import load with a potential export load would require sensitive, proprietary information regarding the customer base and shipment commitments of each ocean carrier. The ocean carriers are extremely unlikely to divulge such information for reasons of both commercial advantage and cargo security.

Communication needs

The virtual CY, like its physical counterpart, would be a place where the containers are interchanged and the required paperwork is completed electronically. The content of the paperwork must be communicated to the affected parties:

- Motor carriers must be able to receive permission to interchange containers, authorization to off-hire empties directly to depots, and verification that they are relieved of liability when their possession ends.
- Ocean carriers must be able to permit “street” interchange, request and receive authorization to off-hire containers, and verify responsibility for their equipment at any point.
- Leasing companies must be able to authorize empty off-hire either at a depot or “in place” somewhere else.

Most of these communications are now conducted by fax or hard copy forms. There already exist EDI protocols for comparable messages (e.g. bills of lading), and there appear to be no significant technical barriers to passing such messages through a virtual CY. One significant advantage of electronic communication is that information can flow directly into stakeholder databases and records without manual entry and delay.

Other Requirements

To serve the purposes outlined above, a virtual container yard must also:

- Differentiate by type and ownership of container
- Maintain unbroken liability, inspection, and responsibility records
- Allow tracking and tracing of empty container location, possession, and status
- Facilitate market penetration and usage expansion as need and volume grow

An important observation is that multiple virtual CYs might emerge. While it is easier to envision a single system and participants would no doubt prefer to deal with just a single system, there is no technical or operational reason why two or more parallel systems could not function.

Virtual CY Roles and Responsibilities

Once a virtual CY is up and running the day-to-day transactions and activity would primarily involve ocean carriers and motor carriers. Other parties, however, will also have roles to play and responsibilities to discharge if the system is to reach its full potential.

Ocean carriers

Ocean carriers are, ordinarily, the providers of both containers and chassis.

- Ocean carriers would provide electronic data on box specifications, any limitations on reuse, per diem rates and conditions, and return location instructions.
- Similar information would be provided on chassis.
- Ocean carriers might also post the availability of empty containers at depots or other locations to facilitate reuse of these boxes before having them drayed to the harbor.
- Ocean carriers would have to re-start the free time allowance (the “per diem clock”) where required for reloading with export cargo and may also have to electronically shift liability.

Motor Carriers

Since the trade imbalance generates large net numbers of empty containers, most truckers will be in the position of trying to dispose of excess empties most economically. (This overall perspective was confirmed in interviews and meetings.) Truckers will be looking for opportunities to interchange empties rather than hauling them back to the harbor, and for other opportunities to dispose of empties without incurring the long wait at terminal gates. The process could look like this:

- Truckers with excess empties on hand would post information on selected empties and initiate reuse and interchange procedures.
- Truckers with excess empties to interchange would dray them back to their own yard or to a neutral location for inspection and interchange.
- Truckers with boxes to be off-hired would seek off-hire authorization and, if appropriate, a payment or allowance for off-hiring the unit.
- Truckers looking for empties would review postings to find suitable boxes with sufficient free time (or an ocean carrier willing to restart free time) in appropriate locations.
- Once a box was interchanged, both truckers would probably notify the ocean carrier.

Leasing Companies

Leasing companies are only involved when their containers are on-hired or off-hired. The leasing companies do not ordinarily do business directly with motor carriers, shippers, or intermediaries. They would not usually be involved in reuse decisions, but their participation would be critical in

depot-direct off-hires. Leasing companies may be involved in alternative off-hire arrangements, accepting boxes for depot-direct off-hire, or agreeing to off-hire boxes “in place” at marine or inland locations:

- Leasing companies would have to electronically authorize depot-direct off-hiring since returning a container to the depot (instead of to the marine terminal) effectively shifts it from the ocean carrier’s account to the leasing company’s responsibility. The authorization process and any terms and conditions would be spelled out in the lease agreement between leasing company and ocean carrier.
- Leasing companies might post the inventory of empty boxes available for on-hire.

Marine terminal operators/stevedores

The terminal operators, acting as the ocean carrier’s representatives, may be involved in posting and updating information on:

- On-terminal container status
- Empty disposition instructions

Shippers, consignees, and third parties

Shippers, consignees, or third parties would not be materially involved in the interchange functions of the virtual CY. They would likely be involved, however, if the virtual CY were part of a larger system (such as eModal) used to post the status of containers on the terminal (e.g. Customs clearance, free time remaining, etc). It appears unlikely — and is probably unnecessary — that a virtual CY would ever become a “clearing house” or dispatching system where export loads were posted for drayage service, since exporters invariably have existing relationships with individual drayage firms.

VI. Potential for Empty Container Reuse

Overview

Southern California is one of the world's largest markets for imports and the location of many distribution centers and other facilities that receive imports for other markets. As the section on empty container flows notes, over 1.1 million import containers were emptied in the region in 2000 (Exhibit 6). Virtually all of these containers were trucked empty back to the marine terminals. At the same time, a large number of empty containers were trucked from the marine terminals to be loaded with exports. If it were economically, operationally, and legally possible to reuse emptied import containers for export loads, there could be a material reduction in the total number and length of truck trips. Determining the potential for empty container reuse is a major focus of this study.

Only an estimated 2% of the empty import containers handled by local draymen are reloaded ("street turned") at present. For a variety of reasons discussed below only a small portion of the empty containers can ever be reused for export loads. The potential for expanded reuse may be roughly 5-10%. While an increase from 2% to 5% or 10% does not appear dramatic, the large number of containers at stake creates a substantial impact.

Container Reuse Opportunities

There are three kinds or levels of reuse opportunities:

- Opportunities within the customer base of each trucking firm
- Opportunities within the customer base of each ocean carrier
- Open or selected opportunities across company boundaries

The vast majority of reuse opportunities are for dry containers. Reuse or interchange of "specials" (reefers, tanks, etc.) is viewed as very complex and impractical. Both owned and leased containers could be covered by reuse strategies, with provision for off-hiring of leased containers (discussed separately).

Opportunities within the customer base of each trucking firm

This is the most common kind of reuse at present, reportedly averaging 2-5%. No "street interchange" between truckers is required. This option is also restricted to the customer base of a single ocean carrier since containers can only be reused by customers of the same line. Reuse within a trucker's customer base could be maximized by:

- Giving truckers additional information on export opportunities

- Re-starting the free time allowance (both container and chassis) for confirmed bookings
- Sharing equipment within ocean carrier alliances

This type of reuse does not require an internet-based “virtual container yard”, but could benefit from one.

Opportunities within the customer base of each ocean carrier

Allowing different truckers serving the same ocean carrier’s customer base to interchange boxes would broaden reuse opportunities. This type of reuse presently occurs on a very limited basis where pairs of truckers regularly interchange boxes for specific accounts.

Reuse within an ocean carrier’s customer base could be maximized by:

- Giving truckers additional information on export opportunities
- Facilitating interchanges between truckers
- Shifting liability to the second trucker after a “street interchange”
- Re-starting the free time allowance (both container and chassis) for confirmed bookings.

This type of reuse would benefit from an Internet-based virtual CY as opposed to each ocean carrier having their own system or handling the transaction over the telephone. This type of reuse has the greatest near-term potential for expansion without major changes to current business practices.

Open or selected opportunities across company boundaries

This is the most ambitious kind of reuse opportunity and requires the most changes to existing procedures. While this is the type of ideal reuse system often envisioned, it is the least likely to be realized in the near future.

For truckers to maximize the containers available for reuse:

- Institute sharing within alliances and off-hire/on-hire of leased boxes without return to depot (short of the truly interchangeable so-called “gray box”)
- Re-start the free time allowance (both container and chassis) for confirmed bookings.
- Give truckers (or post on the virtual CY) information on export opportunities.

These are major institutional changes and are unlikely in the near future.

For ocean carriers to maximize reuse opportunities across multiple truckers:

- Facilitate off-depot and off-terminal “street” interchanges
- Re-start the free time allowance (both container and chassis) for confirmed bookings.
- Minimize and post restrictions on reuse of each box.

This type of reuse would also benefit from an Internet-based virtual CY as opposed to each ocean carrier having their own system or handling it over the phone.

“Street Turns” and Interchange Issues

Intermodal industry participants already interchange empty containers to some extent. The problem is not that interchange of empty containers is impossible, but that it is uncommon and inconsistent in application. In this and previous projects Tioga team members have interviewed drayage firms about “street turns” (the practice of reusing an empty container for a new load) and about the extent of interchange between drayage firms. The study team found that drayage firms would like to increase interchange and reuse of empties, but are limited by informational, institutional, and competitive factors.

The requirements for “street turns” are institutional and informational:

- The drayage firm must locate the opportunity for reuse by an exporter and communicate the opportunity to the driver, and perhaps to another competing drayage firm.
- The drayman’s interchange agreement with the ocean carrier must allow for such reuse and the ocean carrier must be able to track and document the interchange between parties.
- The emptied import container must be in economically reasonable proximity to the exporter, and must be available with sufficient free time within the customer’s loading window.
- The emptied import container must be suitable for the export load, and the container/chassis combination must be acceptable at the terminal used by the export vessel.

Drayage firms and their owner-operator drivers have the most to gain from “street turning” containers. There is no straightforward, consistent way for drayage firms to interchange containers at present, but some drayage firms have found ad hoc methods. For example:

- Some drayage firms “hoard” empty containers from selected ocean carriers since they know specific customers will usually need them for export loads later (usually within a few days). This strategy requires thorough knowledge of the customer base and careful monitoring of free time.

- Some customers (e.g. import consignees who are also export shippers) take possession of the container through a “paper interchange” at their dock so they can reuse the box for an export load. These paper interchanges may create a useful precedent for broader “street interchange” programs.
- A few drayage firms have taken advantage of ocean carrier alliance policies for interchanging containers among partners to widen the opportunities for street turns.

Based on numerous interviews and meetings, the overall perspective of drayage firms can be summed up as follows:

- Drayage firms generate large numbers of empty containers and are looking for opportunities to reuse them. (At least one firm has faxed messages seeking users for empty equipment but received no responses.)
- Reported empty import container reuse ranges from 1% to 3% of the local import loads, with a few firms higher due to special circumstances (e.g. exceptional customer match-ups).
- Interchange of equipment between drayage firms has been extremely limited.
- Draymen use eModal and the systems of individual terminals to check container status.
- Drayage firms feel that a “virtual container yard” would facilitate maximum reuse.
- Structural and institutional factors limit the maximum potential for reuse.

Limits on Container Reuse

There are several key factors that limit the ability of truckers and ocean carriers to reuse empty import containers for exports.

- Import/export timing or location mismatch (e.g. too slow or too distant)
- Ownership mismatch (e.g. wrong steamship line)
- Type mismatch (e.g. wrong size, wrong type, or tri-axle chassis required for heavy exports)
- Off-hiring of leased containers
- Lack of steamship line incentives

Import/export timing and location

To be reused, a suitable container must be in the right place at the right time.

The time element is relatively straightforward. There must be enough free time remaining on the container for it to be interchanged, drayed to the export shipper, loaded, and drayed to the harbor.

The “right place” needs a flexible definition: if the container must be relocated too far, the more economical choice may be to return it to the harbor. Ideally, the exporter would be located very near the importer, and the interchange would take place in a neutral spot nearby. While such arrangements may be optimal they are also rare.

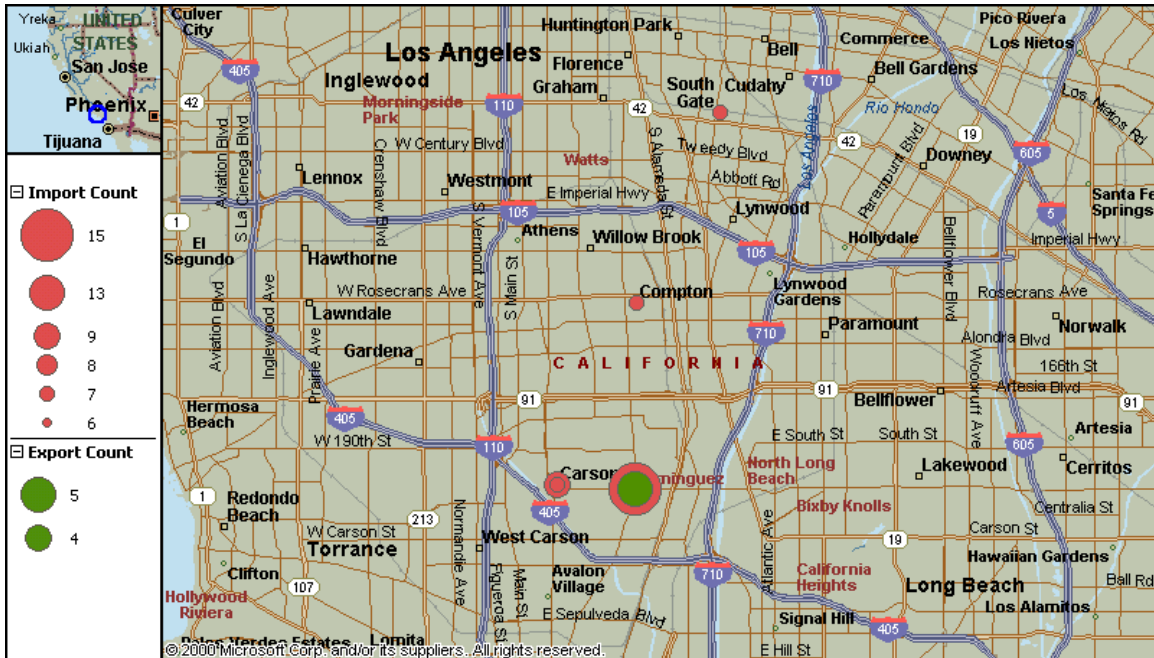
Exhibit 11, drawn from the terminal surveys conducted by Meyer, Mohaddes, displays the major destinations (import customers) and origins (export customers) reported for loaded containers. Note that the only area showing up with appreciable traffic in both import and exports is the Gateway Cities area just north of the ports.

Exhibit 11
Import and Export Locations



Exhibit 12, on a larger scale, shows the location of the combined activity as northwest of the 405/710 junction.

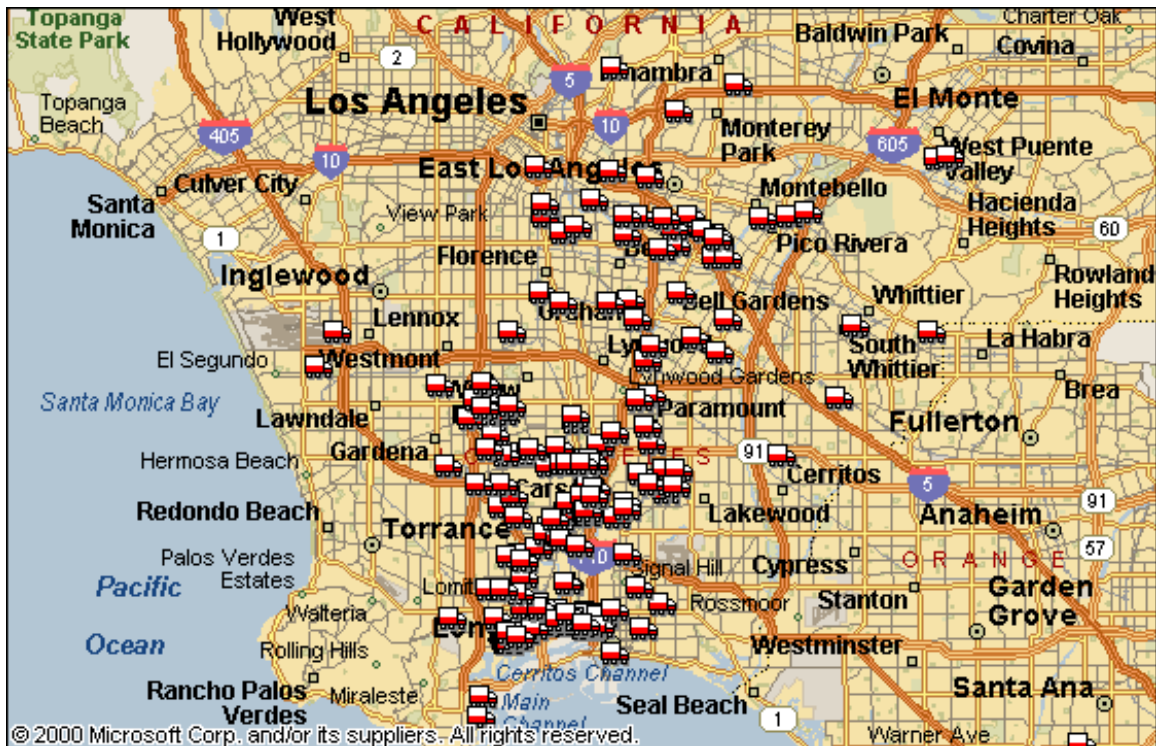
Exhibit 12 Import and Export Locations



While this is probably not the only location with both import and export activity, the available information suggests that such coincidences are the exception rather than the rule. The Inland Empire area, for example, shows up primarily as a destination for imports rather than as a source of exports.

Exhibit 13 shows that drayage firms are clustered in the same areas with a heavy concentration in the Gateway Cities north of the ports. Not surprisingly, drayage firms are equally well situated for import and export flows. Their location does not appear to be a barrier to reuse or other rationalization opportunities.

Exhibit 13
Drayage Firm Locations



Equipment Ownership

Containers are either owned or leased by an ocean carrier and are ordinarily used only by that carrier's customers. For example, an Evergreen container would only be used for Evergreen customers, and a container under lease to NYK line would be used only by NYK customers. This also means that a GE-SEACO container under lease to Evergreen could not be used for an NYK load, despite the fact that NYK may be leasing identical GE-SEACO containers for itself.

There are three alternatives:

- First, ocean carrier alliances (two or more ocean carriers sharing operations, terminals, and vessel capacity) could choose to share equipment fleets. While this has happened to a very limited extent, it is uncommon due to managerial and institutional barriers within the alliances.
- Second, carriers can interchange leasing company boxes under some circumstances (the Transamerica Greybox program was developed to facilitate this process). As explained in the section on existing systems, however, interchange between ocean carriers is usually employed for large blocks of container capacity, not individual movements.
- Third, the development of a fully interchangeable "gray box" would allow and perhaps routinize individual interchanges. (The "gray box" concept is so named

because of the carriers' traditions of painting their containers a distinctive color. A "gray box" would not be identified with a specific carrier. The generic concept should be distinguished from the SynchroNet/Transamerica Greybox system, which is a proprietary service offering.)

Chassis ownership is also complex. Most chassis are provided by the ocean carriers but some leased chassis are in marine terminal pools or shared by alliance members. Most often, chassis ownership is the same as container ownership and has the same restrictions. While pool chassis may offer greater overall flexibility, once they are mated to a container they follow the container's restrictions. Even if the container could be used by another ocean carrier the chassis usually cannot and must be returned to the owner, handicapping the economics of reuse (since exchanging chassis would be slow and costly). Chassis logistics is a major stumbling block for the off-dock empty return concept.

The United States is unique in this respect. In every other country, truckers, customers, or pool operators own and manage the chassis. In the long run it is possible and even likely that U.S. practice will evolve to match the rest of the world. With truckers, customers, or third parties supplying chassis the flexibility of the system would be greatly increased.

Off-hiring of leased containers

As noted in the section on empty container logistics, ocean carriers attempt to minimize the size of their container fleet wherever possible. In regions of surplus, such as Southern California, most carriers attempt to off-hire leased containers. Thus, a carrier may *prefer* that a leased import container be returned for off-hiring rather than loaded with exports. Given that roughly half of the world's container fleet is leased, this preference for off-hiring significantly reduces the maximum potential for reuse. Such containers would be a better candidate for depot-direct off-hire rather than local reuse. A few carriers are indifferent about reloading leased containers.

Import & Export Commodity Mix and Equipment Types

It would be most convenient if the same party who emptied an import container could reuse it for an export load. This happy circumstance, however, is unusual. Most major importers are not exporters, and vice versa.

As Exhibit 14 below shows, the largest U.S. importers of containerized goods are major retail chains such as Wal-Mart and Target or food and beverage distributors such as Dole and Heineken. The goods they bring in are overwhelmingly consumer products, produce, beverages, and electronics. These commodities typically move in 40' or 45' high-cube "dry van" containers (plain boxes without refrigeration or other special features).

The largest exporters move chemicals, paper, and forest products. These commodities are heavy, and tend to move more often in 20' dry van containers. Waste paper moves in 40' units, but is a very low-rated commodity and sometimes shunned by carriers when the container supply is tight. Note that only one firm, General Electric, is both a major importer and a major exporter. Even General Electric, however, has numerous subsidiaries and plants and is unlikely to handle large

quantities of imports and exports at the same location, much less use the same type of containers for both.

Exhibit 14
Top U.S. Importers & Exporters by TEU
(Southern California Companies Shown in **Bold**)

20 Largest U.S. Importers			20 Largest U.S. Exporters		
1	Wal-Mart	Retailer	1	El du Pont	Chemicals
2	Dole Food Co.	Produce (SA)	2	America Chung Nam	Waste Paper
3	Target Corporation	Retailer	3	Weyerhaeuser	Forest Products
4	Chiquita Brands Intl	Produce (SA)	4	International Paper	Paper
5	Heineken USA	Beverages	5	Dow Chemical	Chemicals
6	Kmart Corp.	Retailer	6	Cargill	Food Products
7	The Home Depot	Retailer	7	General Electric	Conglomerate
8	Payless ShoeSource	Retailer	8	Proctor & Gamble	Consumer Goods
9	Brauerei Beck GmbH & Co	Beverages	9	ConAgra	Food Products
10	Costco Wholesale Corp.	Retailer	10	Westvaco	Paper Products
11	General Electric	Conglomerate	11	Pacific Forest Resources	Forest Products
12	Matsushita Electric	Electronics	12	Philip Morris	Tobacco
13	Sony Corp. of America	Electronics	13	Georgia-Pacific	Forest Products
14	Toyota Motor Sales	Auto	14	DaimlerChrysler	Auto/Truck
15	Mattel, Inc.	Toys	15	Exxon Chemicals	Chemicals
16	Bridgestone/Firestone	Tires	16	Potential Industries	Waste Paper
17	Hasbro, Inc.	Toys	17	Engelhard Corp.	Chemicals
18	Michelin NA	Tires	18	IBP	Beef
19	Pier 1 Imports	Retailer	19	USG Corp	Building Products
20	Lowe's Companies	Retailer	20	Linden Trading Co.	Waste Paper

The same point can be illustrated by a review of the top containerized commodities handled at Southern California ports. (Exhibit 15)

Exhibit 15
Top San Pedro Bay Import & Export Commodities

2000 Import Commodity	%	Running Total	Typical Container Type	2000 Export Commodity	%	Running Total	Typical Container Type
Consumer Goods	49%	49%	40'	Plastics & Chemical Products	14%	14%	20'
Electrical Equipment	16%	65%	40'	Pulp & Waste Paper	12%	26%	20'-40'
Light Industrial Machinery	5%	69%	40'	Fruits & Vegetables	9%	34%	Reefer
Auto Parts/Motorcycles	4%	73%	40'	Grain	8%	42%	20'
Other Min & Metal Manufactures	4%	77%	40'	Consumer Goods	8%	51%	40'
Textile, Leather & Rubber Matls	3%	80%	40'	Textile Fibers; Hides	6%	57%	20'
Fruits & Vegetables	3%	84%	Reefer	Specialty Chemicals	5%	62%	20'
Food Products	2%	86%	40'	Paper	5%	67%	20'
Iron & Steel	2%	88%	20'	Meat, Fish & Dairy Products	5%	72%	Reefer
Plastics & Chemical Products	2%	90%	40'	Food Products	4%	76%	40'
All Other	10%	100%	40'	Electrical Equipment	4%	80%	40'
				Light Industrial Machinery	3%	83%	40'
				Cement, Lime & Stone	2%	85%	20'
				Auto Parts/Motorcycles	2%	87%	40'
				Pharmaceuticals	2%	89%	40'
				Textile, Leather & Rubber Matls	2%	90%	40'
				All Other	10%	100%	40'

The import commodity flows are dominated by 40' and refrigerated containers while the exports have a much higher percentage of 20' equipment needs.

Lack of Steamship Line Incentives

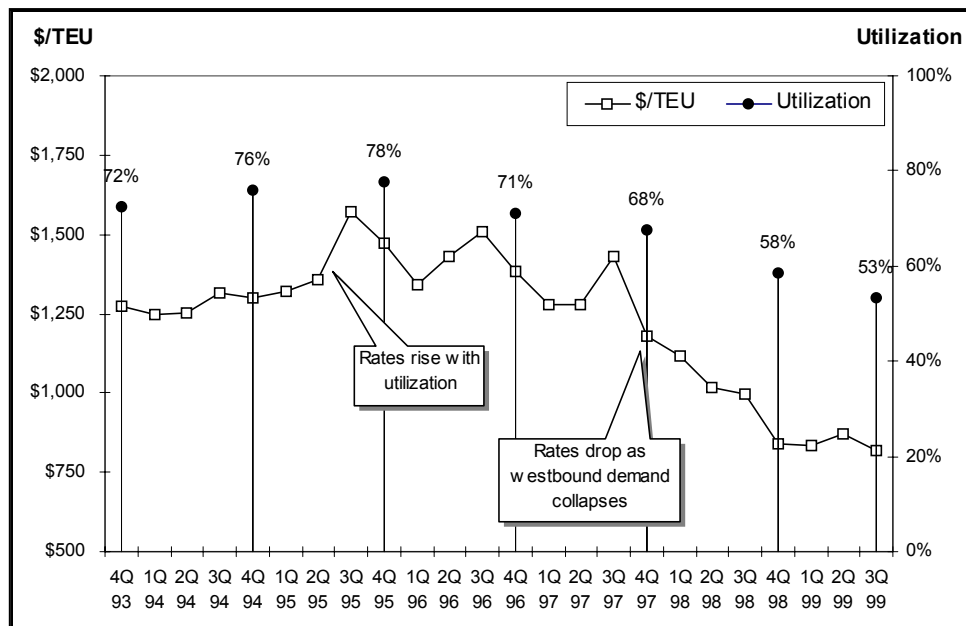
Incentives are critical: neither ocean carriers nor truckers will participate unless it is in the clear interests of both. Ocean carriers are not always motivated to encourage or facilitate street turns:

- Ocean carriers want their empty containers back to satisfy the needs of foreign shippers for eastbound shipments, and westbound export rates are now so low that there is little incentive to wait for an export load.
- The ocean carriers prefer local billing, delegate store-door moves to the customer's house draymen, and do not want to become involved in drayage issues.

Deterioration of westbound export rates has reduced carrier incentives to reuse containers for exports. As shown in Exhibit 16, the massive imbalance in the transpacific trade has resulted in excess capacity and poor utilization on the westbound voyage. The excess of supply over demand has depressed rates to the point where some ocean carriers have stopped soliciting the lowest-rated export commodities and are simply moving more containers back empty. A few new carriers have entered the trade who do not solicit westbound traffic at all.

In view of these economic realities, it is understandable that ocean carriers would hesitate to invest management attention and resources in reusing empty import containers for export loads. Some carriers interviewed by the team expressed no interest, saying that they would prefer to get import containers back promptly and would not extend free time for export loading. Other carriers took a broader view, and would be willing to extend free time in return for a reduced total drayage bill and better overall container fleet utilization.

Exhibit 16 Westbound Transpacific Vessel Utilization and Container Rates



Source: Liner Shipping Network, Drewry's Container Market Outlook 1999

Near-term Reuse Potential

Exhibit 6 shows the estimated frequency of container reuse under existing conditions, about 2%. There is no way to precisely estimate the maximum potential because the underlying data are imprecise and the circumstances are complex and individualized. The study team believes, however, that the percentage can at least double if information systems are improved and institutional barriers are overcome, and this view is generally supported by the trucking community. The more successful truckers approach 5% reuse now, with a few much higher due to special circumstances.

Exhibit 17 shows the different trip patterns for the existing empty return norm and empty reuse or "street turns". Each street turn saves two net trips:

- The drayman need not return the empty to the harbor (one less trip).
- Instead, the drayman takes the empty container to the exporter or to a neutral exchange location (one added trip).
- The drayman avoids one trip to the harbor, and one terminal outgate move. If there is an outbound container or chassis move, it would start a new cycle. If not, the drayman avoids a bobtail outgate move (one less trip).
- The empty move from the harbor to the exporter is avoided (one less trip).

Thus, there are three trips avoided and one move added, a net savings of two trips.

Exhibit 17
Empty Container Reuse Trips

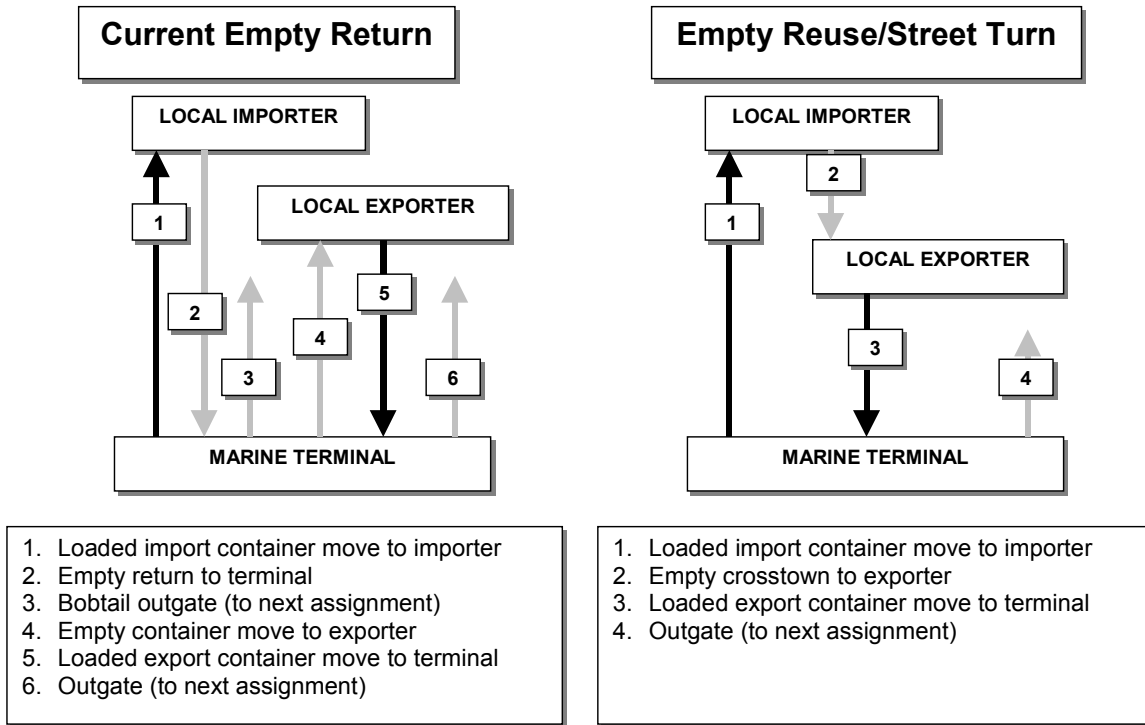


Exhibit 18 shows the consequences of increasing the reuse of empty import containers from 2% to 5%, the “Tier I” scenario. For the year 2000:

- The annual number of empties reused for export loads would have risen from 26,561 in the Base Case to 66,403, an increase of 39,842 units, or about 109 per day. Each of these empties would have moved cross-town between customer locations, perhaps via a trucker parking lot or neutral interchange point..
- The number of empties drayed from the port terminals for export loading would have decreased by the same amount, as would the number of import empties drayed to the terminals. Two container trips would have been avoided for each cross-town move.
- As noted earlier, the number of non-revenue “bobtail” terminal outgate moves would also decline by the same number.
- The net impact is a reduction of 86,457 annual truck trips, or an average of 237 trips per day.

The table show slightly more than two net trips saved per street turn because there is also a small percentage reduction in off-hiring flows to depots.

The consequences increase with cargo growth. By 2020, an increase in reuse from 2% to 5% would have saved almost 348,000 annual truck trips, an average of 953 trips per day.

The impact would increase proportionately if reuse rose to 10% (the Tier II scenario, Exhibit 19).

- The annual number of empties reused for export loads would have risen from 26,561 in the Base Case to 132,806, an increase of 106,245 units, or about 291 per day. Each of these empties would have moved cross-town between customer locations, perhaps via a trucker parking lot or neutral interchange point..
- The net impact would be a reduction of 230,552 annual truck trips (including reduced bobtails) or an average of 632 trips per day.
- By 2020 the net reduction would be 927,980 annual trips, or about 2,542 truck trips per day.

Exhibit 18
Tier I Increased Empty Container Reuse —5%

	2000		2010		2015		2020	
	TEU	Units	TEU	Units	TEU	Units	TEU	Units
Port Inbound/Eastbound	1,245,609	673,302	2,594,497	1,402,431	3,419,149	1,848,189	4,710,528	2,546,231
Via Rail	22,169	11,983	80,413	43,467	116,400	62,919	170,494	92,159
On-Dock Intermodal	22,169	11,983	80,413	43,467	116,400	62,919	170,494	92,159
Via Truck	1,223,439	661,319	2,514,083	1,358,964	3,302,749	1,785,270	4,540,034	2,454,072
Off-Dock Intermodal	51,728	27,961	187,631	101,422	271,600	146,811	397,820	215,038
Local for Export Loading	943,429	509,962	1,919,283	1,037,450	2,420,913	1,308,601	3,218,262	1,739,601
SSL Off-Hires to Depots	228,281	123,395	407,169	220,091	610,236	329,858	923,951	499,433
Port Outbound/Westbound	3,489,445	1,846,344	6,223,866	3,291,583	9,327,899	4,935,052	14,123,255	7,473,827
Via Rail	278,128	150,339	501,602	271,136	731,291	395,293	1,084,536	586,236
On-Dock Intermodal	278,128	150,339	501,602	271,136	731,291	395,293	1,084,536	586,236
Via Truck	3,211,317	1,696,005	5,722,265	3,020,447	8,596,608	4,539,760	13,038,719	6,887,591
Off-Dock Intermodal	564,600	305,189	920,401	497,514	1,491,797	806,377	2,366,438	1,279,156
Local from Import Loads	2,020,639	1,092,237	3,724,141	2,013,049	5,487,061	2,965,979	8,222,357	4,444,517
Local from WB Domestic Loads	64,897	35,079	105,793	57,186	171,471	92,687	272,004	147,029
Repo Off-Hires from Depots	326,116	176,279	581,670	314,416	871,766	471,225	1,319,930	713,476
Local Empties from Transloads	235,065	127,062	390,259	210,951	574,513	310,547	857,989	463,778
Bobtail Trip Change		-39,842		-72,669		-107,055		-160,365
Port Subtotal	4,735,053	2,519,646	8,818,363	4,694,014	12,747,048	6,783,241	18,833,783	10,020,058
On-dock rail	300,297	162,323	582,015	314,603	847,691	458,211	1,255,031	678,395
Truck through Terminal Gates	4,434,756	2,357,323	8,236,348	4,379,411	11,899,357	6,325,029	17,578,752	9,341,663
Cross-Town Truck Factor	220,681	119,287	398,562	215,439	591,617	319,793	890,438	481,318
Local Off-Hires to Depots 3%	78,366	42,360	142,763	77,169	210,089	113,561	314,378	169,934
IM Off-Hires to Depots 3%	19,469	10,524	31,738	17,156	51,441	27,806	81,601	44,109
Reused empties for exports 5%	122,846	66,403	224,061	121,114	330,088	178,426	494,459	267,275
Grand Total	4,955,734	2,638,933	9,216,925	4,909,453	13,338,665	7,103,034	19,724,221	10,501,376

Exhibit 19
Tier II Increased Empty Container Reuse —10%

	2000		2010		2015		2020	
	TEU	Units	TEU	Units	TEU	Units	TEU	Units
Port Inbound/Eastbound	1,114,164	602,251	2,354,751	1,272,839	3,065,955	1,657,273	4,181,457	2,260,247
Via Rail	22,169	11,983	80,413	43,467	116,400	62,919	170,494	92,159
On-Dock Intermodal	22,169	11,983	80,413	43,467	116,400	62,919	170,494	92,159
Via Truck	1,091,994	590,267	2,274,338	1,229,372	2,949,555	1,594,354	4,010,962	2,168,088
Off-Dock Intermodal	51,728	27,961	187,631	101,422	271,600	146,811	397,820	215,038
Local for Export Loading	820,584	443,559	1,695,222	916,336	2,090,825	1,130,176	2,723,803	1,472,326
SSL Off-Hires to Depots	219,682	118,747	391,485	211,613	587,130	317,368	889,339	480,724
Port Outbound/Westbound	3,358,000	1,708,890	5,984,121	3,040,877	8,974,705	4,565,711	13,594,184	6,920,567
Via Rail	278,128	150,339	501,602	271,136	731,291	395,293	1,084,536	586,236
On-Dock Intermodal	278,128	150,339	501,602	271,136	731,291	395,293	1,084,536	586,236
Via Truck	3,079,872	1,558,550	5,482,519	2,769,741	8,243,414	4,170,418	12,509,647	6,334,331
Off-Dock Intermodal	564,600	305,189	920,401	497,514	1,491,797	806,377	2,366,438	1,279,156
Local from Import Loads	1,913,850	1,034,514	3,527,341	1,906,671	5,197,114	2,809,251	7,787,889	4,209,670
Local from WB Domestic Loads	64,897	35,079	105,793	57,186	171,471	92,687	272,004	147,029
Repo Off-Hires from Depots	313,832	169,639	559,264	302,305	838,758	453,382	1,270,484	686,748
Local Empties from Transloads	222,693	120,375	369,719	199,848	544,275	294,203	812,832	439,368
Bobtail Trip Change		-106,245		-193,783		-285,481		-427,640
Port Subtotal	4,472,163	2,311,141	8,338,872	4,313,716	12,040,661	6,222,984	17,775,640	9,180,814
On-dock rail	300,297	162,323	582,015	314,603	847,691	458,211	1,255,031	678,395
Truck through Terminal Gates	4,171,866	2,148,818	7,756,857	3,999,113	11,192,969	5,764,773	16,520,610	8,502,419
Cross-Town Truck Factor	339,841	183,698	615,902	332,920	911,802	492,866	1,370,064	740,575
Local Off-Hires to Depots 3%	74,681	40,368	136,041	73,536	200,186	108,209	299,544	161,916
IM Off-Hires to Depots 3%	19,469	10,524	31,738	17,156	51,441	27,806	81,601	44,109
Reused empties for exports 10%	245,692	132,806	448,122	242,228	660,175	356,851	988,918	534,550
Grand Total	4,812,004	2,494,838	8,954,774	4,646,635	12,952,463	6,715,850	19,145,704	9,921,389

The impacts of the two reuse scenarios are summarized in the exhibit below.

Exhibit 20
Summary Empty Container Reuse Impacts

	2000		2020	
Scenario	Additonal Units Reused	Net Trip Reduction	Additonal Units Reused	Net Trip Reduction
Tier I - 5% Reuse	39,842	86,457	160,365	347,992
Tier II - 10% Reuse	106,245	230,552	427,640	927,980

Long-Term Reuse Potential

The long-term potential for container reuse would improve significantly under certain plausible scenarios:

- Emergence of “gray box” interchangeable containers.
- Marine terminal congestion and cost escalation
- Increased westbound export demand and higher ocean shipping rates
- Evolution of trucker or third-party chassis supply

Each of these developments would remove institutional barriers or increase ocean carrier incentives to allow, facilitate, and promote reuse of empty containers. These same developments would increase the potential for off-dock empty return depots and depot-direct off-hiring.

VII. Potential for Off-Dock Empty Return Depots

The Empty Return Depot Concept

Some stakeholders and industry observers have suggested the establishment of off-dock empty return points to serve as buffer storage or neutral points for interchange and reuse. The objectives of establishing or expanding empty return depots would be to:

- Establish a neutral supply point for reusable empties
- Facilitate empty returns when terminal gates are closed
- Add buffer capacity to the marine terminals
- Avoid additional trips with off-hired leased boxes

Truckers ordinarily return empty containers and chassis to the marine terminal where they originated. While there are several off-dock container depots, they are typically used by ocean carriers and container leasing companies to store and repair excess empty containers. Most such depots are located very close to the ports. Drivers are rarely directed to drop empties at container depots (“depot-direct” off-hiring). Off-dock empty return depots (or expanded functions for existing depots) might let drivers drop off empties without waiting in marine terminal queues.

In concept, off-dock empty return depots would accept empty containers for one or more marine terminals and ocean carrier clients. Empty containers accumulated at the off-dock depots could be:

- reused for exports (effectively “street turning” the container)
- selectively repositioned to marine terminals in off-peak hours,
- sorted and redirected to terminals chosen by alliance partners, or
- stored until marine terminals or outbound vessels can accommodate them.

Presently, drayage firms can sometimes pick up empties from customers during the evening for delivery to marine terminals the next day. Whenever they do so, drayage firms are effectively using their own capacity as a buffer and they must be able to park containers off-dock for later retrieval and handling. Since ocean carriers increased container per diem to \$44 per day to encourage rapid turns, however, drayage firms are less willing to trigger per diem charges by pulling an empty container a day early. The increased difficulty of informal buffering of this kind is one of the reasons drayage firms are pushing for off-dock empty container return depots.

The establishment and use of off-dock empty return depots would therefore facilitate empty interchange, replace informal empty container buffering options, and reduce daytime empty container movements to the harbor.

Roles and Responsibilities

To be attractive to both truckers and ocean carriers, off-dock empty returns would require:

- A bobtail move to the harbor to avoid having to wait in terminal queues with an empty chassis.
- Efficient, low-cost shuttle drayage for empties and savings from freeing space at the marine terminal.

Truckers would drop selected empties on chassis at off-dock depots and continue bobtail to the marine terminal for the next import load. Accumulated off-dock empties would be shuttled to marine terminals during night or early morning hours.

Potential

The Tioga team originally viewed off-dock depots for empty containers as a high-potential component of an overall empty container logistics strategy, and added a subtask to explicitly address the feasibility and potential benefits of off-dock empty return and interchange.

In the short term the concept of off-dock empty return may have only limited application, since total cost would likely be higher than at present. Ocean carriers would incur off-dock storage costs and drayage shuttle costs, and truckers would incur detour costs.

Chassis logistics may be a serious barrier. Ocean carriers often need the chassis back quickly, and if drivers have to return with the chassis they may as well return with the box too.

A second major issue is incentives. If there is enough room at marine terminals and truckers still have to return chassis to the harbor, there is little if any incentive to drop empty boxes off-dock unless off-hiring or reusing. If they would still have to take chassis to the harbor, truckers would only benefit if they were compensated for detours.



If, however, marine terminals are becoming crowded in peak periods, carriers may choose to keep more empties off-dock. Stevedoring Services of America (SSA) subsidiary, Shipper's Transport operates an off-dock depot in Southern California (shown at left) that accepts empty returns on a limited basis. SSA reports encouraging traffic increases and interest by steamship lines.

Given the limited near-term potential the study team has not included empty return depot operations in the empty container logistics strategy or estimated the potential impacts.

Long-Term Potential

The concept of off-dock empty return may have considerable *long-term* promise. In the long-term, congested marine terminals and a shift to trucker-provided chassis would make a large difference in the economics. In particular, the high capital cost of expanding on-dock container storage where land is in short supply might justify the higher operating cost of off-dock storage. Off-dock empty storage is common in other countries, especially in ports such as Hong Kong where shortage of space for marine terminals forces operators to shift everything possible off-dock. It appears likely that similar practices will emerge in the US, once the major economic and institutional barriers are crossed.

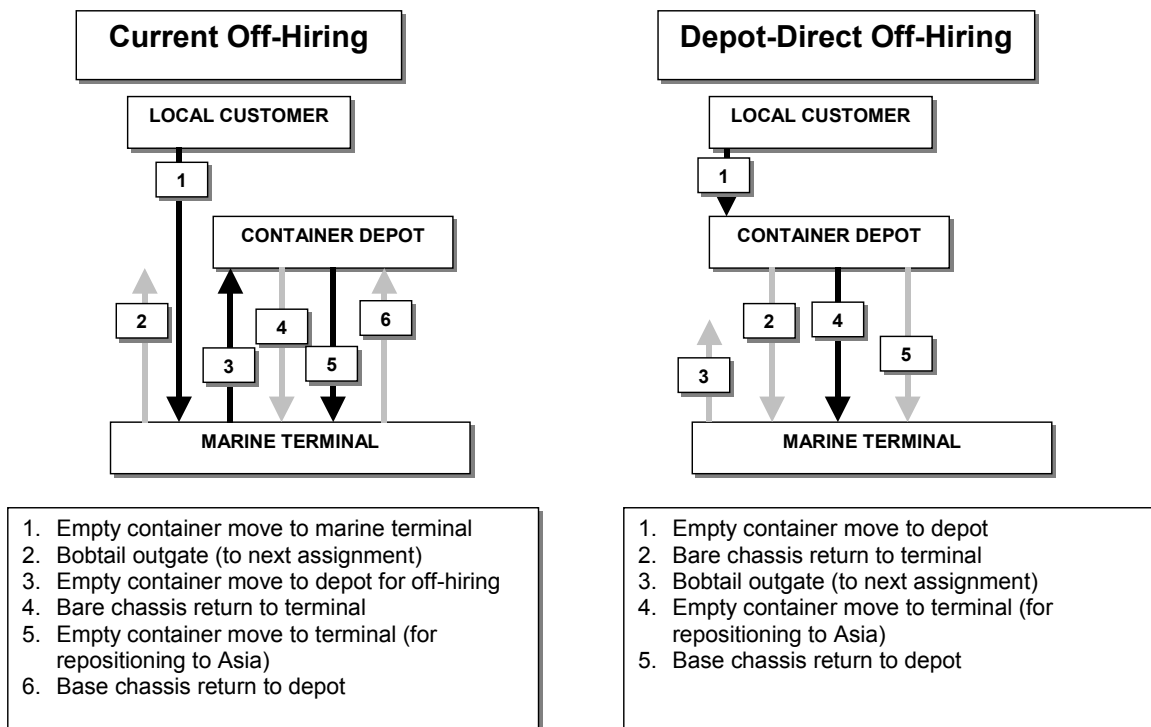
VIII. Potential for Depot-Direct Off-Hires

The Depot-Direct Off-Hiring Concept

The process of off-hiring and repositioning an empty leasing company container typically requires six one-way truck trips at present (Exhibit 21):

- The drayage firm that handled the import load returns the empty container on chassis to the marine terminal, and leaves for another assignment (two trips). Half the time, on average, the driver will depart “bobtail” without a container or chassis.
- Ocean carriers off-hire excess empty leasing company containers by having them drayed on chassis to off-dock depots authorized to accept them. The drayage drivers typically return with the empty chassis since it will be needed for other business. (two trips)
- Leasing companies must eventually reposition most of the empties to Asia, and have them drayed on chassis to a marine container terminal (which may be different from the one they came from). The drayman typically returns with the empty chassis. (two trips)

Exhibit 21
Depot Off-Hiring Trips



A process the study team has named “depot-direct” off-hiring (Exhibit 21) would cut at least one truck trip from each off-hiring and repositioning cycle, making a total of five instead of six one-way truck trips:

- The drayage firm that handled the import load would identify the container as being subject to off-hiring and take it directly to the off-dock depot instead of to the marine terminal. (one trip)
- At worst, the driver would have to take the bare chassis back to the marine terminal and leave bobtail (two trips) At best the opportunity could be used to dray a different empty to the harbor for repositioning, with the chassis then returned to its owner.
- Leasing companies would still reposition many of the empties to Asia, draying them to the port and returning with an empty chassis. (two trips) At best, with improved planning, this trip could take an off-hired container from another location to the depot.

Thus, each depot-direct off-hire would avoid *at least* one truck trip.

Implementation

To implement and expand depot-direct off-hiring, ocean carriers would:

- provide consistent electronic information on empty return locations,
- select empties to be dropped at off-dock depots, and
- compensate truckers accordingly.

Truckers would drop empties as instructed by ocean carriers, and the leasing companies would accept direct returns/off-hires from the truckers.

Truckers already move some leased boxes directly to depots for off-hires. The study team has established that the most common management information system in use for marine terminal operations does provide for sending depot-direct off-hire instructions to truckers. That capability is rarely used, however. The limiting factors are:

- Lack of advance planning by the ocean carriers to identify off-hires when the trucker picks up the import load.
- The need for communicating off-hire instructions in real time, since paper documents often lag actual movements and dispatching decisions.
- Provision of appropriate compensation for driver detours to depots, especially in peak season.

Some major ocean carriers are already investigating increased depot-direct off-hires.

Near-Term Potential

Depot-direct off-hiring has considerable promise as a means of rationalizing empty container flows.

- Based on interviews, it appears that ocean carriers may off-hire about 10% of their westbound empties, or about 180,000 total units in 2000.
- At present, draymen deliver approximately 3% of the empties directly to off-dock container depots for “off-hire” and storage.
- An estimated 3% of the intermodal empties are likewise trucked directly to depots instead of to the marine terminals.
- The rest are trucked back and forth, as shown earlier.
- With better information systems and changes to institutional practices, virtually all containers to be off-hired could be delivered directly to depots

Exhibit 22 shows the potential impact on estimated empty container flows.

- In 2000, about 54,000 empty units were off-hired directly to depots (43,555 from local import customers and 10,524 from rail intermodal terminals). About 126,184 empty units were drayed from port terminals.
- Shifting all the empties to depot-direct off-hiring would have increased that depot-direct total to about 180,000 annual units (145,184 from local import customers and 35,079 from rail intermodal terminals).
- The total truck trip savings would be equal to the number of containers affected, 126,184 in 2000, since one trip would be avoided each time.
- By 2020, the net reduction would be 510,658 annual units.

Exhibit 22
Near-Term Depot-Direct Off-Hire Potential

	2000		2010		2015		2020	
	TEU	Units	TEU	Units	TEU	Units	TEU	Units
Port Inbound/Eastbound	1,091,035	589,748	2,321,765	1,255,008	3,006,965	1,625,386	4,083,252	2,207,163
Via Rail	22,169	11,983	80,413	43,467	116,400	62,919	170,494	92,159
On-Dock Intermodal	22,169	11,983	80,413	43,467	116,400	62,919	170,494	92,159
Via Truck	1,068,865	577,765	2,241,351	1,211,541	2,890,565	1,562,468	3,912,758	2,115,004
Off-Dock Intermodal	51,728	27,961	187,631	101,422	271,600	146,811	397,820	215,038
Local for Export Loading	1,017,137	549,804	2,053,720	1,110,119	2,618,965	1,415,657	3,514,937	1,899,966
SSL Off-Hires to Depots	0	0	0	0	0	0	0	0
Port Outbound/Westbound	3,334,871	1,802,633	5,951,134	3,216,829	8,915,715	4,819,305	13,495,979	7,295,124
Via Rail	278,128	150,339	501,602	271,136	731,291	395,293	1,084,536	586,236
On-Dock Intermodal	278,128	150,339	501,602	271,136	731,291	395,293	1,084,536	586,236
Via Truck	3,056,743	1,652,293	5,449,532	2,945,693	8,184,424	4,424,013	12,411,443	6,708,888
Off-Dock Intermodal	519,172	280,634	846,346	457,484	1,371,767	741,496	2,176,035	1,176,235
Local from Import Loads	1,896,699	1,025,243	3,499,696	1,891,728	5,156,959	2,787,546	7,728,722	4,177,688
Local from WB Domestic Loads	64,897	35,079	105,793	57,186	171,471	92,687	272,004	147,029
Repo Off-Hires from Depots	333,487	180,263	595,113	321,683	891,572	481,931	1,349,598	729,512
Local Empties from Transloads	242,488	131,075	402,583	217,613	592,655	320,354	885,083	478,423
Bobtail Trip Change		0		0		0		0
Port Subtotal	4,425,905	2,392,381	8,272,899	4,471,837	11,922,680	6,444,692	17,579,231	9,502,287
On-dock rail	300,297	162,323	582,015	314,603	847,691	458,211	1,255,031	678,395
Truck through Terminal Gates	4,125,608	2,230,058	7,690,884	4,157,234	11,074,989	5,986,480	16,324,201	8,823,892
Cross-Town Truck Factor	382,625	206,825	684,738	370,129	1,023,607	553,301	1,547,382	836,422
Local Off-Hires to Depots 10%	268,591	145,184	489,320	264,497	720,101	389,244	1,077,594	582,483
IM Off-Hires to Depots 10%	64,897	35,079	105,793	57,186	171,471	92,687	272,004	147,029
Reused empties for exports 2%	49,138	26,561	89,624	48,446	132,035	71,370	197,784	106,910
Grand Total	4,808,531	2,599,206	8,957,637	4,841,966	12,946,287	6,997,993	19,126,613	10,338,710

Long-Term Potential

The long-term potential for depot-direct off-hiring could expand considerably if:

- Truckers or other parties begin to provide the chassis, creating flexibility in using the chassis for multiple customers and reducing chassis repositioning needs.
- Container depots and marine terminal operators cooperated to keep draymen moving with containers both ways wherever possible (e.g. draying an empty to the depot to be off-hired and returning with an empty to be repositioned). Chassis flexibility would facilitate this development.

These developments could ideally reduce the number of truck trips in the off-hiring and repositioning cycle from the present five (or the improved four) to just two:

- One trip from import customer to the depot
- One trip from the depot to the port for repositioning

These further improvements would multiple the net truck trip savings from depot-direct off-hiring.

IX. Internet-based Systems

Overview

A major task within the study was to determine the potential for an Internet-based container information system to facilitate the interchange, reuse, return, and management of empty marine containers. In specific, it was envisioned that an Internet-based system could function as a virtual container yard.

There is one system, SynchroMet, that is specifically designed to facilitate street turns and container reuse. That system, however, was introduced on April 22, 2002, just two weeks before the report was finalized, and has barely begun operation. It is described in the sections that follow, but has not been in operation long enough to evaluate.

There are several systems in place that provide some of the functions and services anticipated in this task. There are at least two internet-based systems which facilitate the interchange of empty containers between ocean carriers to redress trade imbalances. Other systems exist to manage domestic containers and container chassis. The Tioga team is familiar with many of these systems, and has reviewed their performance and features as a guide to what might be accomplished. The consultant team did not venture into technical feasibility, systems design, demonstration models, design specifications, or financial evaluation of such systems.

Each system has its own unique set of features and capabilities and many have multiple purposes. They can, however, be divided into three basic types:

- Proprietary ocean carrier and terminal information systems
- Subscription or membership container status information systems
- Container capacity exchange systems

Proprietary ocean carrier and terminal information systems

All major ocean carriers and marine terminal operators have information systems in place to communicate with customers and drayage firms. These vary in sophistication from those that simply offer electronic communication of what used to be paper transactions to those that allow customers or drayage firms to determine the detailed status and availability of specific containers. Most offer container tracking or tracing capabilities. For those most part, each of these systems covers one ocean carrier (and perhaps its alliance partners) or the terminals (perhaps in multiple ports) of one operating company. Virtually all of these systems can be accessed over the World Wide Web. Examples are given below.

Exhibit 23

Examples of Ocean Carrier and Marine Terminal Tracking System Websites

Company	Website
"K" Line Global Cargo Tracking	http://206.103.2.20/GlobalCargoTrck
Hanjin Shipping	http://www.hanjin.com/eservice/cargo/cargo.jsp
Maersk Sealand	http://www.maersksealand.com/
Maher Terminals	http://www.maherterminals.com/services.html

VoyagerTrack

Within Southern California, the best known system of this kind is Marine Terminal Corporation's VoyagerTrack. VoyagerTrack has been developed by Embarcadero Systems Corporation, a subsidiary of Marine Terminals Corporation, and is in use at MTC-operated and affiliated terminals up and down the West Coast as shown at left, including the terminals of Evergreen, Wan Hai, China Shipping Corp., Trans Pacific Line, and Yang Ming in Los Angeles, and Hanjin in Long Beach. Drayage firms in Southern California typically use VoyagerTrack whenever they do business at MTC terminals.



forwarders. It is used to monitor containers, cargo status, and related activities. VoyagerTrack functionality is delivered directly via the Internet and is password-protected for user operations. A user can request to be notified by email or fax when a container is available. A user can also check on a container's associated status such as Customs or USDA clearance, terminal status, and steamship company status, along with making on-line demurrage payments. Other available details include container holds and last free day, demurrage due, and when the terminal will begin releasing empty or receiving full containers. VoyagerTrack Voice delivers much of the same functionality as VoyagerTrack Web, via VRU (Voice Response Unit).

VoyagerTrack does not presently support or facilitate container reuse except to the extent that it gives dispatchers good information regarding container status, last free day, etc.

Regional or port container status information systems

There have been several systems developed by ports or other organizations to provide container status information to the broader port community. In general, these systems enable customers or truckers to access container status information and other features for multiple terminals rather than just those operated by the system provider. One example is the FIRST system, offering

container status data and related information for the Port Authority of New York & New Jersey (www.firstnynj.com). The eModal system is a Southern California example.

eModal.com

eModal.com, LLC was formed in 1999 as a database management company to track and provide container information for terminals and truckers serving the ports of Los Angeles and Long Beach. The company is headquartered in Long Beach.

eModal.com currently operates an expanding container “bulletin board” system, initially for the West Coast container shipping industry but rapidly spreading to the East Coast as well. eModal.com counts over 90 regional trucking firms, 7 ocean carriers, over 30 brokers and third parties, and numerous marine terminals among its members and users.

The structure and purpose of eModal is to:

- Integrate container tracking between marine terminals and the eModal website for multi-modal use.
- Provide benefits to terminals and trucking companies by increasing productivity and reducing “turn times” through the use of coordinated availability planning.
- Properly coordinate modal planning to improve the efficiencies in the harbor area.
- Improve multimodal coordination using a standardized data system.

The eModal system was developed by transportation industry professionals and has attained a high degree of acceptance in the intermodal industry.

The information available for containers at terminals includes:

- Container number
- Equipment type
- Status time
- Status
- Reporting terminal
- Most recent activity
- Voyage name
- Weight
- In-Yard status

eModal customers (“members”) can create “activity folders” to gather information about containers of interest. Customers can use an Activity Folder for inbound cargo, outbound cargo, different shipping lines, or other criteria. Customers can track up to 100 containers, bills of lading, or bookings in an Activity Folder. A sample folder format is shown at right.

Customize Activity Folder

Shippers R Us Default Folder [\(view\)](#)

Rename Folder

Shippers R Us Default

Column	Column Number
Container ID	1
Reporting Terminal	2
Status Time	3
Status Description	4
Weight	5
Most Recent Activity	6
Bill Of Lading	
Booking Number	
Equip. Status	
Equipment Type	
Lloyds #	
SCAC	
Special Handling	
Vessel	
Voyage	

Trucking companies also use eModal to pre-approve their drivers for container pick up and drop off. eModal automatically sends this pre-approval information to the terminals. So, when truckers arrive at a terminal, they spend less time waiting at the gate. Terminals also rest assured knowing they are delivering containers to the trucking company's designated drivers.

The eModal Depot Manager feature provides a depot inventory and management tool. Using eModal's Web-based technology, depots can monitor and track their gate and yard activity. The eModal Depot Manager categorizes container, chassis, reefer, and trailer equipment, as shown below.

Exhibit 24
eModal Depot Manager Inventory Viewer

Depot Manager

EModal

Welcome back
Eric Silver

Inventory Viewer

Approval

Gate-In

Gate-Out

Yard Transaction

Admin

eModal Admin

Reports

Preferences

Equipment Search:

[Home](#) [About Depot Manager](#) [Contact eModal](#) [Help](#)

Inventory Viewer
 Inventory Listing in the terminal

Sel	Equipment No	Size / Type	Container No	Chassis No	Genset No	Full	Hazmat	Customs	Damage
	<input type="text"/>	All <input type="button" value="v"/>				All <input type="button" value="v"/>	All <input type="button" value="v"/>	All <input type="button" value="v"/>	All <input type="button" value="v"/>
<input type="radio"/>	APLU1234567	40DH		APLZ12345		Full	No	No	No
<input type="radio"/>	APLUCNT1234	20FR				Empty	No	No	No
<input type="radio"/>	APLZ12345	40CH	APLU1234567			Empty	No	No	No
<input type="radio"/>	ARMSCH123	20CH			ARMSGN129	Empty	No	No	No
<input type="radio"/>	ARMSCNT123	20FR				Empty	No	No	No
<input type="radio"/>	ARMSGN129	GS		ARMSCH123		Empty	No	No	No
<input type="radio"/>	BNSFCNT4890	20FR				Empty	No	No	No
<input type="radio"/>	CHBELL123	20CH			GNBELL123	Empty	No	No	No
<input type="radio"/>	CHJAN0301	40CH				Empty	No	No	No
<input type="radio"/>	CHOOUL1228	40CH				Empty	No	No	No
<input type="radio"/>	CNT87690879	20FR				Empty	No	No	No
<input type="radio"/>	CNBELL123	20HT				Full	No	No	No
<input type="radio"/>	CNTJAN0301	20FR				Full	No	No	No
<input type="radio"/>	CNTSMRA8901	20FR				Empty	No	No	No
<input type="radio"/>	CQ7726576	20CH				Empty	No	No	No

Tracking begins as the container goes out the marine terminal gate. Using eModal's Web-based technology, a container is identified and its location and time-stamps are accurately tracked, recorded and reported.

The system has recently introduced “eModal Scheduler”, which provides marine terminals and trucking companies the capability to schedule pick-up and deliveries. When and if this capability is used by most industry participants marine terminals will have the ability to plan for an efficient level of trucks at their terminal within given timeframes. Drivers will know in advance that they are expected and have been scheduled as part of the timeframe work plan. Marine terminals should be able to "flatten" their gate activity to an efficient level and reduce, or at least manage, queuing time for the truckers.

eModal plans to add additional features:

- Issue and receive delivery orders
- Pay demurrage on a secure server
- Get information from more terminals
- See live camera views of terminal gate lanes
- Assign work to truck drivers
- Assign containers to booking numbers

eModal does not yet have a specific feature to support container reuse, although it reportedly has such a feature under development.

Container capacity exchange systems

Several systems have been developed to assist ocean carriers with managing and rationalizing their worldwide container fleets. In general, these systems assist ocean carriers in posting and exchanging information on container surpluses or shortages.

- **InterBox** is a service provided by International Asset Systems. InterBox is an Internet-based trading system that facilitates the exchange of shipping container capacity in a secure, business-to-business environment. InterBox participants include IMCs and third parties, container leasing companies, and ocean carriers. InterBox is discussed in greater detail below
- **SynchroNet Marine**, based in Northern California, offers multiple services designed to enable ocean carriers, IMCs, and others match up empty container capacity with shipment demand and move excess boxes at the lowest possible cost. **Greybox** was originally a service of Transamerica Leasing, one of the largest container leasing companies, and is now part of SynchroNet. Greybox provides an electronic internet bulletin board on which participating carriers can post information on container surpluses and deficits. SynchroNet has recently introduced **SynchroMet**, a container street-turn and reuse system.

IAS/InterBox

International Asset Systems (IAS) was founded in 1998 by container industry veterans and e-commerce pioneers who saw the potential cost savings and efficiencies that an online container booking and reservation service would bring to ocean carriers. Through an integrated suite of applications surrounding the IAS Hub (a centralized data repository) IAS provides global equipment visibility, container event management and analysis, exchange of equipment and vessel slot capacity, and other services using data from diverse carrier and vendor systems within the transport chain. IAS offers an integrated suite of systems and services:

- **IAS Event Manager:** Enables ocean carriers, container logistics providers, and their trading partners to monitor and update equipment as it moves along the transport chain.
- **IAS Transport Manager:** An on-line service that enables ocean carriers and logistics providers to tender, view, and track container transport orders.
- **IAS Depot Manager:** A gate event and M&R data capture and communication service that streamlines the container reporting process for ocean carriers, equipment lessors, and their global networks of depot operators.
- **InterBox:** A Web-based container booking and interchange system, including an intermodal reservation module.
- **IAS Hub:** An advanced infrastructure that performs data processing and translation, business rule execution, and database functions for all IAS services.

The IAS Event Manager uses IAS Hub data to provide end-to-end visibility and management of container events and streamlines and standardizes communication between ocean carriers and their trading partners as containers move along the transport chain. The IAS Event Manager facilitates reduced equipment idle days and quick turnaround on empty containers. The intended benefits of IAS Event Manager include:

- Reduced container and chassis turn time
- Fewer empty drays
- Increased utilization of empty units
- Improved data to drive empty container redeployment decisions

IAS Event Manager operates through direct system integration or a Web interface, where authorized users can view and verify container events. For example, IAS Event Manager tracks a container moving inland over the "last mile" from a marine terminal to a consignee's facility with "pre-arrival notifications," "gate in," "container stripping," and "gate out" functions. Obviously, IAS Event Manager capabilities depend on the ability of the participants to submit information on a timely basis.

InterBox enables container owners, operators and transport service providers to search for and transmit surplus or deficit containers for interchange:

- Users first define their surplus or deficit needs: location, equipment type, quantity, economic value, etc.
- InterBox then searches for and lists complementary opportunities available for immediate action.
- Users can accept one of the solutions presented in the search results or make counteroffers.
- Transactions are completed online through a direct real-time offer/counteroffer process.

Used in this way, InterBox would enable truckers to post their inventories of excess empty containers with a zero asking price, effectively becoming a virtual container yard. InterBox has not yet been used for this purpose to any great extent and it remains to be seen how well it can perform this function for local and regional motor carriers as proposed to global ocean carriers.

Eventually InterBox will become fully integrated with the IAS Hub. The IAS Hub will post excess equipment to InterBox based on Event Manager data and carrier-defined rules. In addition to reducing manual work, this feature will facilitate container interchange closer to the point where containers are available for the next export load, further reducing drayage costs. InterBox partners will also be able to use the Event Manager to monitor the equipment's location and track its return to the original supplier.

SynchroNet/SynchroMet

SynchroNet Marine, Inc. provides container interchange, asset management, and cost optimization services for ocean carriers. SynchroNet was founded in 1996 and is headquartered in San Ramon, CA. SynchroNet provides four services :

- **SynchroBox** provides ocean carriers with the ability to review and select potential container interchanges in a real-time online environment. The service assists ocean carriers to efficiently reposition equipment from inland or coastal points.
- **SynchroSource** assists ocean carriers to search SynchroNet's entire database for available container capacity that meets specific origin/destination requirements.
- **SynchroSlot** is a notice board that covers all trade lanes throughout the world and enables customers to reposition empty equipment and access incremental revenue generating opportunities.
- **SynchroMet** is a “congestion management tool” to facilitate and track street turns. It also provides many of the same industry information features as eModal

SynchroBox, SynchroSource, and SynchroSlot support ocean carriers seeking to rationalize worldwide container surpluses and deficits and manage the international flow of container capacity. SynchroNet's Cooperative Access System (CAS) is a secure database engine used to analyze container inventory data and surplus/deficit information from multiple ocean carriers to cooperation opportunities..

SynchroMet is the only system introduced to date with the specific purpose of facilitating street turns and empty container reuse. SynchroMet has been introduced in the Metropolitan Bay Area with the support of the Port of Oakland.

- Phase 1 facilitates off-dock street-turns between trucking companies serving the Port of Oakland. Inbound containers can be posted as empty street-turn opportunities and matched in real-time with off-dock equipment needs to cover export bookings.
- Phase 2 will enable shipping lines to interchange equipment at local inland points for repositioning to international demand locations. Further development of SynchroMet will be prioritized through ongoing dialogue with community member groups.

SynchroMet claims the system allows users to:

- Establish a profile of preferred trading partners
- Communicate via phone, fax, or hosted email service using a secure platform
- Post equipment availability information
- Search for equipment opportunities in real time
- View and easily track street-turns directly on-line
- Communicate street turn confirmations
- Access vital information about terminal operations

The SynchroMet web interface was designed with assistance from local trucking companies to ensure it is user friendly and easy to navigate. SynchroMet also provides truckers with information on port and terminal operations, customer service, and contact information with links to steamship line and leasing company websites.

SynchroMet is a subscription-based service:

- For companies with 1-20 trucks, the monthly subscription is \$40.00
- For companies with 20+ trucks, the monthly subscription is \$80.00

Assessment of Internet Systems Potential

There is not yet a fully operational, well-used Internet system to facilitate empty container reuse and interchange. Existing systems, however, are moving in that direction.

- **eModal** is a well-used container status system with additional features, and is reportedly developing the capability to support container reuse and interchange.
- **InterBox** is an industry container capacity exchange system with the capability to be used as a virtual container yard, but is not yet commonly used in that capacity.
- **SynchroMet** is specifically design to facilitate street turns but is brand new.

These three systems and others mentioned above are converging on the container reuse issue from different directions. While conventional thinking would envision a single system used by the entire industry, there is no reason why two or more competing systems could not emerge (a good example is the existence of competing industry-wide airline reservations systems, e.g. Sabre and Apollo). It is likely that the industry will continue to progress towards a workable and working virtual container yard system without a need for public sector intervention. Moreover, a key factor in the acceptance of existing systems is their industry roots: all the successful system have been developed by intermodal and marine industry professionals, with systems features dictated by industry experience.

X. Institutional Issues and Risk Management

Institutional barriers

The major barriers to rationalizing empty container movements are not technical or economic, but institutional. It must be remembered that the incentives for ocean carriers and truckers to reuse containers are relatively small, and that they cannot be expected to go to extraordinary lengths, take risks, or jeopardize profits on other business to optimize empty container flows. Faced with institutional difficulties, management demands, costs, or risks, their rational course of action will be to simply return empties and obtain other containers for export loads.

In the course of interviews and focus group meetings Tioga has identified a number of institutional barriers to increased container interchange. For the most part these barriers make interchange more complex, increase the management and clerical time required, increase costs, or increase liability exposure.

Limited free time

When truckers receive a container and chassis in interchange they are ordinarily allowed five business days of “free time” before “per diem” charges are assessed. Per diem is the daily charge for holding a container past this free time allowance and is currently \$44 for a 40’ dry container. The per diem “clock” begins when the container leaves the marine terminal and runs until the container is returned, unless the ocean carrier and customer make some special arrangement. While it is possible to pull, unload, and return a container in a single day, it more typically takes 2-4 days for the full cycle, leaving very little time to reposition the container for an export load unless additional free time is approved.

Ocean carriers interviewed for this project had different viewpoints: some would readily allow extra free time to obtain an export load while others would enforce free time limits to insure prompt return of empties needed elsewhere.

Managing per diem charges

Ocean carriers impose per diem charges primarily to encourage prompt return of empty containers (and discourage non-maritime reuse), but per diem is also a source of revenue when it can be properly charged and collected. Tracking, charging, and collection per diem is a difficult proposition and ocean carriers are not very successful at it.

- The terms of individual shipper contracts can affect free time and per diem charges, so assessing and collecting per diem becomes complex.
- Ocean carriers typically charge drayage companies for per diem (since it is the drayage company who has received the container and chassis in interchange), but drayage companies typically blame customers for any delay and avoid paying per diem bills unless they can be sure of customer reimbursement.

- Tracking, billing, and attempting to collect per diem charges is time-consuming, costly, and frustrating.

Under these circumstances, ocean carriers are understandably hesitant to further complicate the per diem issue. Drayage firms are reluctant to adopt any practice that would expose them to additional per diem charges since the \$44 per day charge is higher than any profit potential for reusing containers.

Managing repair charges

Damage and repair are constant items of contention between ocean carriers, leasing companies, and truckers:

- Ordinary dry van containers themselves are simple and sturdy, and only occasionally generate damage and repair disputes. Chassis, however, have tires, lights, wiring, brake systems, mud flaps, and sand shoe/crank assemblies that are prone to damage and costly to repair.
- Ocean carriers, leasing companies, and truckers often disagree over who caused the damage, over the amount of damage, and over the difference between damage and ordinary wear and tear. Administering and collecting repair bills is often as expensive as the repairs themselves.

As with the per diem issue, both parties will be reluctant to expand empty container (and chassis) interchange if repair and damage issues are not clarified.

Need for inspection and paperwork at non-customer location

Interchanging a container and chassis typically requires that the parties complete an Equipment Interchange Report (“EIR”, not to be confused with an Environmental Impact Report). The EIR has diagrams for noting any equipment damage or other condition and spaces for basic information about the parties and the particulars of the interchange. The EIR is normally completed at the marine terminal gate or within the container yard. The procedure includes a brief “walk around” inspection of the equipment with the EIR on a clipboard or an electronic equivalent.

To complete a regular “street” interchange between two trucking companies this same process would normally be required, ideally with representatives from both trucking companies present. In case where the two companies trust each other completely or when no damage or other conditions are being found, this procedure might be conducted by one person alone with the results communicated to both firms.

It is commonly imagined that this process would take place at the import customer facility where the container was emptied, and that the container could then be moved to a exporter for loading. This procedure, however, was discovered to be impractical:

- Import customers are very unlikely to permit the second truck driver and tractor onto their property to obtain the container due to security concerns, especially when the import customer will not receive any significant benefit for the interchange process.
- Trucking firms carry insurance policies that indemnify their customer in case of accident. The second trucker's insurance would not indemnify the first trucker's customer, leaving the customer with an unacceptable liability exposure.
- Truckers are reluctant to reveal the identity, location, or business particulars of their customers to potential competitors.

The usual procedure, therefore, would be for the first trucker to retrieve the empty container and park it in his own lot or at a neutral location (perhaps even on the street). The interchange inspection and paperwork would then take place away from the customer's facility.

This requirement is not as burdensome as it may seem. In the common "drop and pick" operations drivers routinely deliver an import container to be unloaded and retrieve a waiting empty from the customer. It is fairly common for drivers to park some of the empties at their home terminal or elsewhere while they deal with higher priority business (e.g. loads or empties approaching the end of their free time). Some truckers report storing empties briefly for customers who routinely need them later in the week. Interchanging empties at a trucker lot or neutral location may therefore be a reasonable evolution of present practice.

Lack of a common or consistent procedure for trucker interchange

Most drayage firms deal with a variety of steamship lines and customers, and would strongly prefer that any procedures for interchanging and reusing containers were standardized. Procedural differences would be a managerial nuisance and a source of errors and friction.

Liability issues

The single largest institutional barrier appears to be liability, especially for accidents.

In the case of a motor vehicle accident or other incident involving a container and chassis, the ocean carrier and the drayage firm find themselves drawn into expensive and time-consuming litigation, with large sums at stake. Under current practices, if drayage firm "A" received the container and chassis from the ocean carrier and passed the equipment on to drayage firm "B" who then had an accident, all three would be involved in a legal battle. Drayage firm "A" would be much more willing to interchange containers if it were released from liability.

The issue of liability in case of accident is intertwined with liability for equipment loss or damage, discussed above. The ocean carrier is concerned that there be no gap in responsibility or liability for either, and that the first trucker does not escape its responsibilities to the equipment owner.

There is currently no readily available mechanism for transferring liability between the first trucker and any subsequent user of the container and chassis. Such a mechanism might resemble an electronic interchange within the Virtual Container Yard where the first trucker electronically returns the container to the ocean carrier who then electronically interchanges it to the second trucker. The difficulty with this process is the loss and damage liability of the first trucker and the inability of the ocean carrier to verify the condition of the equipment (and by extension whether or not to bill the first trucker for any damage).

Risk Management & Legal Issues

The term “risk management” is commonly used in connection with liability and insurance issues. In this context, Tioga understands the application to be much broader, and to encompass the necessary changes in the way intermodal interchange is currently conducted, including legal issues and the handling of liability.

Each party in the intermodal business currently manages their own risk exposure through a combination of legal and procedural safeguards, contractual terms and conditions, and insurance coverage. Changes in interchange processes and objectives necessarily affect the management of risk. Risk management begins with a careful assessment of which party is liable for what at each stage of the process.

Caveat

This section deals with the legal issues involved in the implementation of process changes that may arise by reason of the findings in this study. As a word of caution, legal analysis in hypothetical circumstances may well ignore or be unable to foresee obstructions or circumstances that could arise but are not a part of the present hypothesis. As a result of this fact and in a effort to clearly communicate the probable issues, this analysis will follow hypothetical scenarios and thus be limited to hypothetical terms.

This examination further assumes that the containers and chassis are controlled by a common entity and have a common next use. Obviously, reality may be far more complex. This assumption is made because the variety of possible container and chassis combinations makes a discrete analysis of every variation impractical. Further analysis of these variables would be beyond the scope of this study and better addressed by the parties involved in actual implementation.

Virtual CY Scenario

Hypothetically, a third party to the interchange transaction establishes a neutral website or other system that lists available empty international containers. Container equipment providers (e.g. ocean carriers) and motor carriers contract with the website operator for the use of the site/system to dispose of excess empty equipment or to locate needed equipment for loading. Since the site/system is virtual, the empty equipment will actually be located at a physical site that probably will not be controlled by the equipment provider. It is a reasonable hypothesis that empty containers will be physically present on:

- the premises of import consignees (after unloading);
- the premises of motor carriers that have handled the import load and have to either reload the unit or return it empty to the equipment provider; or
- multi-user off-dock container yards.

The right to possession of and responsibility for damage and return to the equipment provider rests with the motor carrier that last interchanged the equipment from the equipment provider or his agent (terminal, depot operator). To facilitate reuse of the equipment by a third party, the following must be agreed by the import user, the equipment provider, the facility operator and the export user:

- The physical condition of the unit at the time of receipt by the export user;
- The amount of free time available to the export user;
- Willingness of the facility operator to permit the export user to obtain the equipment;
- Authorization of the export user to interchange the equipment.

Assuming that the import and the export users are authorized to interchange the equipment provider's equipment (e.g., are members of UIIA with the equipment provider's addendum current) the thorny legal issue is documenting the equipment condition and documenting agreement on responsibility for damages to the equipment. Normally, in a physical interchange, a third party will inspect the physical condition of the equipment and obtain the signature of the user on the inspection form (J-1, EIR, etc.). This obviously does not exist in a virtual environment in all circumstances. The following are the variables:

- Equipment acquired from a facility operated by importing motor carrier. Here, the importing motor carrier controls the facility and can probably create the necessary interchange document when the equipment is picked up by the export motor carrier.
- Equipment acquired from a multi-user container yard. Depending on the yard there may or may not be a person present to perform an inspection.
- Equipment acquired from the facility of a import consignee. Here, the issues are notifying the consignee to release to the export motor carrier (done frequently at present) and somehow documenting the equipment condition (extremely difficult in many locations yet possible in others having 24-hour/7-day yard security).

Where there is a process to document condition on interchange the virtual website/system can have user Terms and Conditions that bind the users to responsibility in accord with the inspections. Where there is no such process the legal underpinning for resolving such potential disputes is more problematic.

The final legal element requires the equipment provider's agreement to the change in possession of the equipment and the reinitialization of free time for the export move. In the domestic rail intermodal marketplace this concept is known as a "flying interchange" or a "street turn". In the existing context, the equipment provider allows qualified users to change the status of equipment thereby ending the free time on one move with one user while commencing a new move with another user. This is often handled by facsimile or verbally. In the virtual CY environment, the website would provide a facility which records the transaction and then notifies the equipment provider electronically requesting reauthorization of the two moves. The legal structure for this transaction could be handled by the Terms and Conditions of the website.

Depot-Direct Off-Hiring Scenario

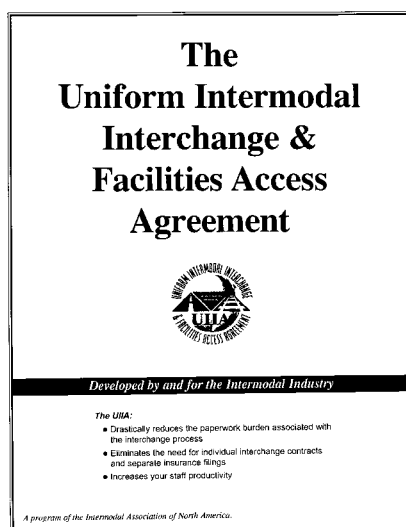
In this scenario, rather than returning import empties to marine terminals they are returned to off-dock depots directly after unloading. This occurs when the equipment provider no longer needs the equipment and intends to off-hire the containers to their owner or master lessor.

While the participants are fewer (import motor carrier, equipment provider, and depot operator) the issues are similar. In essence, once the import motor carrier is notified to terminate the equipment to an off-hire site, there will be an inspection and termination of the equipment. Since only one motor carrier is involved, there should be no issue as to responsibility for per diem or equipment damage. There are no particular thorny legal issues with this process.

UIIA Framework

In interviews, some truckers stated that ocean carrier interchange agreements prohibiting interchange were a significant institutional barrier. This view may not be accurate.

While there are many agreements between parties covering the interchange of intermodal containers, the agreement with the widest applicability and use is the Uniform Intermodal Interchange & Facilities Access Agreement (UIIA). The UIIA is administered by the Intermodal Association of North America, and participants include 8 railroads, 45 ocean carriers, and over 4,500 motor carriers.



The UIIA does not specifically prohibit "street" interchange. Its basic language, however, anticipates that the party who is using the equipment (the trucker) will return it to the party who provided it (the ocean carriers). Cautious truckers or carriers might interpret this as a prohibition on street turns.

Key provisions of the UIIA contemplate the need for supplementary agreements to facilitate empty container interchange:

“4. Restrictions Upon Equipment Use

Absent contrary Agreement between the parties, Motor Carrier shall use the Equipment only for the purposes for which it was interchanged and shall promptly return it to the location at which it was received.”

“7. Liability, Indemnity, and Insurance

c. If the Equipment is interchanged by Motor Carrier or is otherwise authorized by Motor Carrier to be in the possession of another party, the Motor Carrier shall be responsible for the performance of all terms of this Agreement in the same manner as if the Equipment were in the possession of the Motor Carrier, unless the written consent of Provider has been obtained.”

The UIIA provides a framework that can be relatively easily modified to add participants in order to include all necessary contracting parties and to bind them into a legally enforceable agreement. The UIIA is also positioned to handle scanning of interchange records and resolution and apportionment of equipment provider claims.

The existing UIIA document treats motor carriers ("MC") as equipment users and equipment providers ("EP") as equipment owners. The agreement design contemplates the MC's being responsible to the EP's for equipment condition, return, use charges, and indemnity. Two changes may be needed:

- First, MC's in the proposed process will attain new rights and obligations relating to the receiving MC indemnifying the tendering MC for EP charges and indemnity after interchange of the equipment.
- Second, EP's will have to agree to "street interchange" the containers and chassis so as to restart the per diem "clock" for the outbound segment.

Both are significant changes which mandate both redesign and rewording of the agreement. The changes should be relatively easy to draft and implement. Changes to the UIIA must be approved by the Executive Committee and, once approved, come into effect without further action. Thereafter, if a EP (ocean carrier) or MC (trucker) does not agree with the changed UIIA, they must terminate their membership in order to avoid the effect of the changes. Informal contacts suggest that the UIIA Executive Committee members would look favorably on expansion of their functionality in a manner to support the virtual CY concept.

Conceptually, the changes could be similar to the following.

“New Section: STREET INTERCHANGE

- 1. Any MC may directly interchange Equipment with any other MC authorized to interchange Equipment with its Provider upon the following terms and conditions:*
 - a) The EP is notified at the time of proposed interchange of the receiving MC;*

- b) *The receiving and tendering MC's agree, in writing or other documentary means, as to the physical condition of the Equipment at the time of interchange;*
 - c) *The tendering MC indemnifies the receiving MC for any and all claims relating to Equipment condition, Equipment charges and third party liability prior to the time of interchange;*
 - d) *The receiving MC indemnifies the tendering MC for any and all claims relating to Equipment condition, Equipment charges and third party liability subsequent to the time of interchange;*
2. *Upon notification by an MC in compliance with 1a) hereof, EP shall change its records to reflect the change of possession from tendering to receiving MC; shall end the per diem liability of the tendering MC and initiate a new interchange per diem with the receiving MC. For the purposes of this Agreement, a 'street interchange' shall have the same force and effect as though the Equipment was returned to the EP and interchanged anew to the receiving MC."*

This example is a skeletal version of what the changes might look like.

There could also be a provision which compelled arbitration of disputes among the EP and two MC's with respect to physical damage to the Equipment and in whose possession the "damage" occurred. The modes will need to work through this issue as it remains the most difficult to handle operationally.

Tioga was unable to examine other contractual agreements, since these are basically confidential, so no examples of contracts that actually prohibit street interchange were located.

XI. Empty Container Logistics Strategy

Overview

The goal of an empty container logistics strategy is to maximize the ability of the port and intermodal community to reuse empty containers for export loads and rationalize empty container returns. Reusing empties for export loads and rationalizing returns means fewer, shorter drayage trips and fewer gate transactions for the same total cargo. Making empty container information available on the Internet is expected to maximize the chances for reuse through street turns. By creating the “virtual container yard” described in a previous section, an Internet system would enable truckers to rationalize empty returns and interchange.

Any empty container logistics strategy must be effective and practical. The intermodal industry is complex but obeys one simple rule: the participants’ motivation is commercial, not altruistic, and an empty container handling strategy must yield concrete financial and operational benefits to be successfully implemented.

A successful empty container logistics plan should satisfy several criteria and provide sufficient net benefits to stakeholders to create incentives for ongoing use:

- Reduce VMT for empty containers
- Reduce trips to Port marine terminals, the number of empties on terminal, and empty container dwell time.
- Offer economic and operational benefits to trucking companies and other stakeholders, and net benefits to the region

The elements of an effective empty container logistics strategy will likely include:

- A role for an Internet-based information system, specified in terms of functions performed rather than system features or software specifications
- Increased reuse of empty import containers for export loads
- Increased depot-direct off-hiring

Combined Scenarios Potential

Exhibit 25 below summarizes the combined impact of increased reuse and depot-direct off-hiring. The potential savings in trips is large.

Exhibit 26, on a following page, displays the impact of the combined scenario on the estimated base case empty container flows.

Exhibit 25
Empty Container Trip Savings

	2000	2010	2015	2020
Base Case	2,725,390	5,067,144	7,335,344	10,849,368
Tier I - 5% Reuse	2,638,933	4,909,453	7,103,034	10,501,376
Trips Saved	86,457	157,691	232,310	347,992
Tier II - 10% Reuse	2,494,838	4,646,635	6,715,850	9,921,389
Trips Saved	230,552	420,508	619,494	927,980
Depot-Direct 10%	2,599,206	4,841,966	6,997,993	10,338,710
Trips Saved	126,184	225,178	337,351	510,659
Combined Scenario	2,376,091	4,435,022	6,398,482	9,440,665
Trips Saved	349,299	632,122	936,862	1,408,703

The combined scenario, incorporating both increased reuse of empty import containers for exports and increased depot-direct off-hiring, would maximize the net truck trip reduction. In 2000, such a strategy would save 349,299 annual trips, or about 956 per day. By 2020, the annual total would reach 1,408,730 and the daily trip savings would average 3,859.

Exhibit 26
Combined Scenario Empty Container Flows

	2000		2010		2015		2020	
	TEU	Units	TEU	Units	TEU	Units	TEU	Units
Port Inbound/Eastbound	894,481	483,503	1,963,267	1,061,225	2,478,825	1,339,905	3,292,118	1,779,523
Via Rail	22,169	11,983	80,413	43,467	116,400	62,919	170,494	92,159
On-Dock Intermodal	22,169	11,983	80,413	43,467	116,400	62,919	170,494	92,159
Via Truck	872,312	471,520	1,882,853	1,017,759	2,362,425	1,276,986	3,121,623	1,687,364
Off-Dock Intermodal	51,728	27,961	187,631	101,422	271,600	146,811	397,820	215,038
Local for Export Loading	820,584	443,559	1,695,222	916,336	2,090,825	1,130,176	2,723,803	1,472,326
SSL Off-Hires to Depots	0	0	0	0	0	0	0	0
Port Outbound/Westbound	3,138,317	1,590,143	5,592,636	2,829,264	8,387,575	4,248,343	12,704,845	6,439,843
Via Rail	278,128	150,339	501,602	271,136	731,291	395,293	1,084,536	586,236
On-Dock Intermodal	278,128	150,339	501,602	271,136	731,291	395,293	1,084,536	586,236
Via Truck	2,860,189	1,439,803	5,091,034	2,558,128	7,656,284	3,853,051	11,620,308	5,853,607
Off-Dock Intermodal	519,172	280,634	846,346	457,484	1,371,767	741,496	2,176,035	1,176,235
Local from Import Loads	1,739,596	940,322	3,209,912	1,735,088	4,730,013	2,556,764	7,088,953	3,831,866
Local from WB Domestic Loads	64,897	35,079	105,793	57,186	171,471	92,687	272,004	147,029
Repo Off-Hires from Depots	313,832	169,639	559,264	302,305	838,758	453,382	1,270,484	686,748
Local Empties from Transloads	222,693	120,375	369,719	199,848	544,275	294,203	812,832	439,368
Bobtail Trip Change		-106,245		-193,783		-285,481		-427,640
Port Subtotal	4,032,799	2,073,646	7,555,903	3,890,489	10,866,400	5,588,249	15,996,962	8,219,366
On-dock rail	300,297	162,323	582,015	314,603	847,691	458,211	1,255,031	678,395
Truck through Terminal Gates	3,732,501	1,911,323	6,973,888	3,575,886	10,018,709	5,130,037	14,741,931	7,540,971
Cross-Town Truck Factor	559,523	302,445	1,007,386	544,533	1,498,933	810,234	2,259,403	1,221,299
Local Off-Hires to Depots 10%	248,935	134,560	453,470	245,119	667,287	360,695	998,480	539,719
IM Off-Hires to Depots 10%	64,897	35,079	105,793	57,186	171,471	92,687	272,004	147,029
Reused empties for exports 10%	245,692	132,806	448,122	242,228	660,175	356,851	988,918	534,550
Grand Total	4,592,322	2,376,091	8,563,289	4,435,022	12,365,333	6,398,482	18,256,365	9,440,665

VMT & Emissions Impacts

Methodology

In order to determine the impacts on traffic and air quality, it was necessary to convert the trips saved for each type of movement described in the previous chapters to an estimated Vehicle Miles Traveled (VMT). It was then possible to estimate emissions impacts by using standard emissions factors for typical drayage tractors.

In the absence of detailed itineraries and GIS data for all the possible trips, a number of simplifying assumptions were made as described below.

Empty Depot Trip Length

Several data sources were used to estimate the trip length to and from various empty container points of origin and destination. The results are graphically summarized in Exhibit 27. The data sources used to estimate trip lengths include address lists of actual empty depot locations along with address lists of leasing companies and customers. The locations of the intermodal rail yards were also used, weighted by annual TEU throughput. Finally, the detailed truck driver origin/destination survey that was conducted for the Ports Transportation Study was used to estimate local trips in the Southern California area. A description of the trip length estimation is provided below.

The intersection of Terminal Island Freeway and Ocean Boulevard was taken as a base reference point to represent the Port of Long Beach and Port of Los Angeles. Trips originating from the Ports will arrive at their destination (i.e. off-dock intermodal, local loading, depot locations, etc.) by accessing the Terminal Island Freeway, I-110, or I-710. Individual trips may be a mile shorter or longer due to the specific location in the Ports. The average, however, will even out due to the multiple destinations in the Ports. The reference point is generally equidistant from the two major freeways and at the base of the Terminal Island Freeway.

Trip Lengths from Ports to Depot Operators

The Tioga Group provided Meyer, Mohaddes Associates with a list of depot operators by address in the Long Beach, Wilmington, and adjacent areas. MMA made an attempt to filter out the addresses that are clearly only offices and not actual depot locations (i.e., some in the World Trade Center, Pine Avenue in Downtown Long Beach, etc.) The remaining locations were plotted and reviewed. It was determined that many of the depot operators are located in an area bounded by Pacific Coast Highway, Alameda Street and the Terminal Island Freeway, and that many of the trips originating from the Ports will use the Terminal Island Freeway to arrive at the depot locations. Although each depot will have its own unique trip length from the Ports, an average trip length of 4 miles was calculated to reasonably represent trip lengths to depot locations.

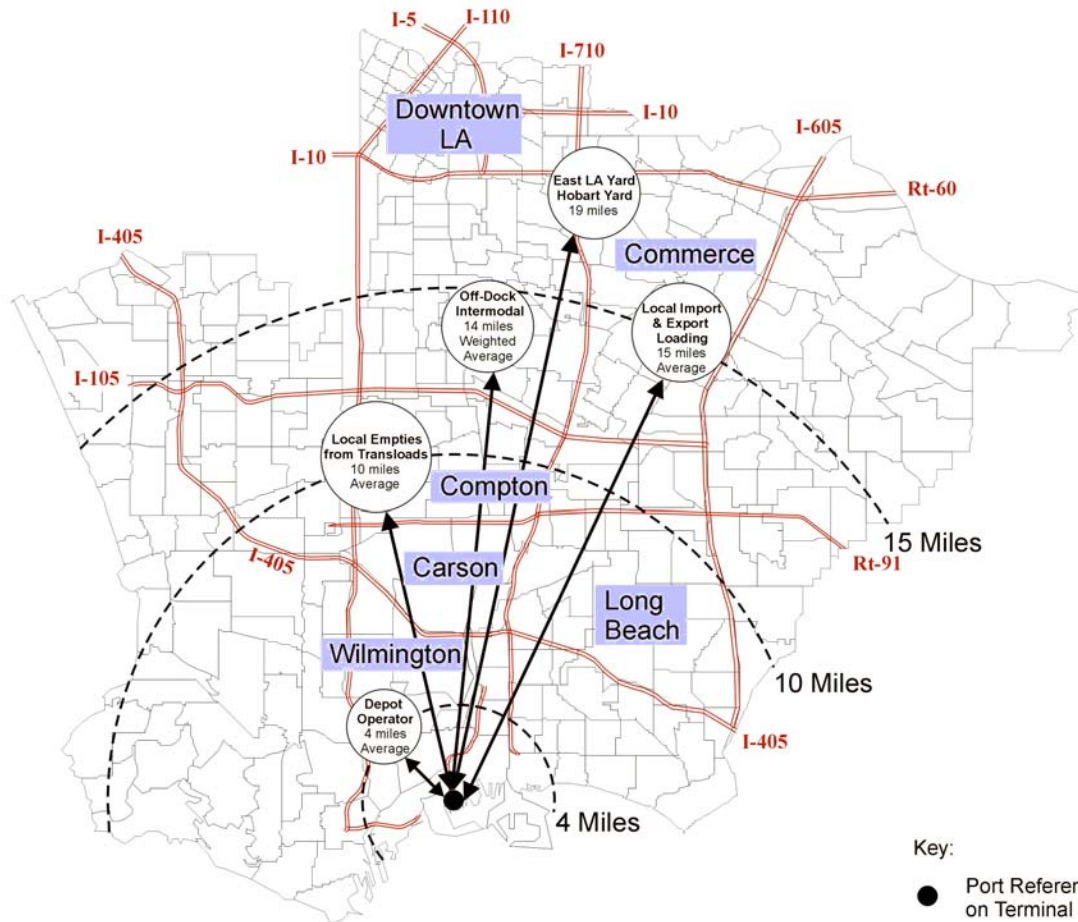
Trip Lengths from Ports to Off-Dock Intermodal Facilities

The off-dock intermodal facilities predominately consist of three major rail-yards: ICTF, East LA Yard, and Hobart Yard. Trips originating from the port will use the Terminal Island Freeway to arrive at ICTF and the I-710 to reach East LA Yard and Hobart Yard. A weighted average trip length of 14 miles representing the three combined rail-yards was calculated based on the trip origin/destination distribution percentage obtained from the Port Transportation Study truck origin/distribution surveys.

Trip Lengths from Ports to Local Export/Import Loading Locations

Local loading locations consisting of warehouses, stores, etc. are located outside of the Ports. Trips originating from the Ports will use the Terminal Island Freeway, I-110, or I-710 to arrive at the local destinations. Since local loading areas are scattered throughout the Southern California area (with a majority in the Port Transportation Model focus area), the Port model was used extensively for this task. Each Traffic Analysis zone was assigned a percentage representing the proportion of Port-related truck traffic to and from that zone. The zones were then aggregated into larger subareas using the freeway system as general boundaries. In this way, the percentage distribution to each larger subarea could be calculated. For example, the total number and percentage of truck trips to and from the area bounded by the I-405, I-605, Route 91, and I-710 was calculated and the average trip length in that area was measured. Then, a similar process was used for trips to all other Los Angeles Basin areas. Finally, a weighted average trip length was developed from those individual average trip length calculations. Based on that analysis, a weighted average trip length of 15 miles was calculated to represent the local loading activity (see Exhibit 27). As can be seen, the 15 mile radius from the Ports includes all trips in the South Bay, Wilmington, Compton, Long Beach, and Carson areas, as well as much of the remainder of the Gateway Cities subregion. Methodology was based on over 3,000 truck driver origin/destination distribution survey forms tabulated for the Ports Transportation Study.

Exhibit 27 Trip Length Map



Empty Ocean Container Movements Average Trip Lengths from the Port

Trip Length Summary

The table below (Exhibit 28) summarizes the estimated and modeled trip lengths for the key trip types involved in empty container movements.

The longest international cargo trips are those for import and export loading. Wherever one or more trips of 14-15 miles can be avoided or replaced by a shorter cross-town move there is a sizable reduction in VMT. For example, a complete import/export cycle with two empty moves would result in an estimated 60 VMT (one 15-mile import load, one 15-mile export load, two 15-mile empty returns). Replacing this with a triangulated empty reuse move generates 45 VMT (one 15-mile import move, one 15-mile reuse move, and one 15-mile export move), a savings of 15 VMT.

Exhibit 28
Trip Length Summary

Trip Type	Average Miles
Eastbound	
Off-Dock Intermodal	14
Local for Export Loading	15
SSL Off-Hires to Depots	4
Westbound	
Off-Dock Intermodal	14
Local from Import Loads	15
Local from WB Domestic Loads	30
Repo Off-Hires from Depots	4
Local Empties from Transloads	10
Bobtails	15
Cross-Town	
Local Off-Hires to Depots	11
IM Off-Hires to Depots	10
Re-used empties for exports	15

VMT and Emissions Impacts

Meyer, Mohaddes developed impact estimates for the Base Case and the four analysis scenarios: Empty Container Reuse, Depot Direct Off hires, and the Combined Scenario. The results are shown in Exhibit 29 through Exhibit 33, and summarized in the following sections.

Exhibit 29
Base Case Impacts

Empty Trip Type	Average Trip Length (a) (miles)	2000			2010			2015			2020		
		Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)
Eastbound													
Off-Dock Intermodal	14.0	27,961	391,458	1,685	101,422	1,419,914	6,113	146,811	2,055,351	8,848	215,038	3,010,533	12,960
Local for Export Loading	15.0	549,804	8,247,056	35,504	1,110,119	16,651,782	71,686	1,415,657	21,234,851	91,416	1,899,966	28,499,492	122,690
SSL Off-Hires to Depots	4.0	126,184	504,737	2,173	225,178	900,712	3,878	337,351	1,349,406	5,809	510,659	2,042,635	8,794
Total		703,949	9,143,251	39,362	1,436,719	18,972,408	81,676	1,899,819	24,639,608	106,074	2,625,663	33,552,660	144,444
Westbound													
Off-Dock Intermodal	14.0	305,189	4,272,648	18,394	497,514	6,965,200	29,985	806,377	11,289,272	48,600	1,279,156	17,908,180	77,095
Local from Import Loads	15.0	1,126,871	16,903,070	72,768	2,076,876	31,153,140	134,114	3,060,016	45,900,242	197,601	4,585,426	68,781,388	296,104
Local from WB Domestic Loads	30.0	35,079	1,052,376	4,530	57,186	1,715,566	7,386	92,687	2,780,609	11,971	147,029	4,410,882	18,989
Repo Off-Hires from Depots	4.0	180,263	721,053	3,104	321,683	1,286,732	5,539	481,931	1,927,722	8,299	729,512	2,918,050	12,562
Local Empties from Transloads	10.0	131,075	1,310,746	5,643	217,613	2,176,125	9,368	320,354	3,203,541	13,791	478,423	4,784,234	20,596
Total		1,778,478	24,259,894	104,439	3,170,871	43,296,763	186,393	4,761,364	65,101,385	280,261	7,219,547	98,802,732	425,346
Cross-Town													
Local Off-Hires to Depots	11.0	43,555	479,107	2,063	79,349	872,841	3,758	116,773	1,284,504	5,530	174,745	1,922,194	8,275
IM Off-Hires to Depots	10.0	10,524	105,238	453	17,156	171,557	739	27,806	278,061	1,197	44,109	441,088	1,899
Re-used empties for exports	15.0	26,561	398,419	1,715	48,446	726,685	3,128	71,370	1,070,554	4,609	106,910	1,603,651	6,904
Total		80,640	982,764	4,231	144,951	1,771,083	7,625	215,949	2,633,119	11,336	325,764	3,966,933	17,078
Grand Total		2,563,067	34,385,909	148,031	4,752,541	64,040,254	275,693	6,877,133	92,374,112	397,671	10,170,973	136,322,325	586,868
Emissions (Tons) (c)													
Carbon Monoxide	13.12	497	2.1			925	4.0		1,335	5.7		1,970	8.5
Total Organic Gases	2.99	113	0.5			211	0.9		304	1.3		449	1.9
Reactive Organic Gases	2.92	111	0.5			206	0.9		297	1.3		438	1.9
Oxides of Nitrogen	11.10	420	1.8			783	3.4		1,129	4.9		1,666	7.2
Exhaust Particulates	1.03	39	0.2			73	0.3		105	0.5		155	0.7

(a) Average trip length based on port model origin/destination data as well as location of Depots and transloading facilities

(b) Annual VMT converted to peak day VMT using peak month of 9.1% of annual, 28 working days per month, and peak day of 123% of average day.

(c) based on EMFAC7F1.1 model year 2010 emissions factors

Exhibit 30
Tier I 5% Empty Reuse Impacts

Empty Trip Type	Average Trip Length (a) (miles)	2000			2010			2015			2020		
		Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)
Eastbound													
Off-Dock Intermodal	14.0	27,961	391,458	1,685	101,422	1,419,914	6,113	146,811	2,055,351	8,848	215,038	3,010,533	12,960
Local for Export Loading	15.0	509,962	7,649,428	32,931	1,037,450	15,561,755	66,993	1,308,601	19,629,020	84,503	1,739,601	26,094,015	112,335
SSL Off-Hires to Depots	4.0	123,395	493,581	2,125	220,091	880,365	3,790	329,858	1,319,430	5,680	499,433	1,997,732	8,600
Total		661,319	8,534,467	36,741	1,358,964	17,862,034	76,896	1,785,270	23,003,802	99,031	2,454,072	31,102,281	133,895
Westbound													
Off-Dock Intermodal	14.0	305,189	4,272,648	18,394	497,514	6,965,200	29,985	806,377	11,289,272	48,600	1,279,156	17,908,180	77,095
Local from Import Loads	15.0	1,092,237	16,383,558	70,531	2,013,049	30,195,737	129,993	2,965,979	44,489,687	191,528	4,444,517	66,667,759	287,005
Local from WB Domestic Loads	30.0	35,079	1,052,376	4,530	57,186	1,715,566	7,386	92,687	2,780,609	11,971	147,029	4,410,882	18,989
Repo Off-Hires from Depots	4.0	176,279	705,116	3,036	314,416	1,257,664	5,414	471,225	1,884,900	8,114	713,476	2,853,904	12,286
Local Empties from Transloads	10.0	127,062	1,270,621	5,470	210,951	2,109,509	9,081	310,547	3,105,473	13,369	463,778	4,637,777	19,966
Bobtails	15.0	-39,842	-597,628	-2,573	-72,669	-1,090,028	-4,693	-107,055	-1,605,831	-6,913	-160,365	-2,405,477	-10,356
Total		1,696,005	23,086,692	99,388	3,020,447	41,153,649	177,166	4,539,760	61,944,109	266,669	6,887,591	94,073,025	404,984
Cross-Town													
Local Off-Hires to Depots	11.0	42,360	465,960	2,006	77,169	848,861	3,654	113,561	1,249,176	5,378	169,934	1,869,273	8,047
IM Off-Hires to Depots	10.0	10,524	105,238	453	17,156	171,557	739	27,806	278,061	1,197	44,109	441,088	1,899
Re-used empties for exports	15.0	66,403	996,047	4,288	121,114	1,816,713	7,821	178,426	2,676,385	11,522	267,275	4,009,128	17,259
Total		119,287	1,567,244	6,747	215,439	2,837,130	12,214	319,793	4,203,622	18,097	481,318	6,319,490	27,205
Grand Total		2,476,610	33,188,403	142,876	4,594,850	61,852,813	266,276	6,644,822	89,151,532	383,797	9,822,981	131,494,795	566,085
Emissions (Tons) (c)													
Carbon Monoxide		13.12	480	2.1		894	3.8		1,288	5.5		1,900	8.2
Total Organic Gases		2.99	109	0.5		204	0.9		294	1.3		433	1.9
Reactive Organic Gases		2.92	107	0.5		199	0.9		287	1.2		423	1.8
Oxides of Nitrogen		11.10	406	1.7		756	3.3		1,090	4.7		1,607	6.9
Exhaust Particulates		1.03	38	0.2		70	0.3		101	0.4		149	0.6
(a) Average trip length based on port model origin/destination data as well as location of Depots and transloading facilities													
(b) Annual VMT converted to peak day VMT using peak month of 9.1% of annual, 28 working days per month, and peak day of 123% of average day.													

Exhibit 31
Tier II 10% Empty Reuse Impacts

Empty Trip Type	Average Trip Length (a) (miles)	2000			2010			2015			2020		
		Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)
Eastbound													
Off-Dock Intermodal	14.0	27,961	391,458	1,685	101,422	1,419,914	6,113	146,811	2,055,351	8,848	215,038	3,010,533	12,960
Local for Export Loading	15.0	549,804	8,247,056	35,504	1,110,119	16,651,782	71,686	1,415,657	21,234,851	91,416	1,899,966	28,499,492	122,690
SSL Off-Hires to Depots	4.0	126,184	504,737	2,173	225,178	900,712	3,878	337,351	1,349,406	5,809	510,659	2,042,635	8,794
Total		703,949	9,143,251	39,362	1,436,719	18,972,408	81,676	1,899,819	24,639,608	106,074	2,625,663	33,552,660	144,444
Westbound													
Off-Dock Intermodal	14.0	305,189	4,272,648	18,394	497,514	6,965,200	29,985	806,377	11,289,272	48,600	1,279,156	17,908,180	77,095
Local from Import Loads	15.0	1,126,871	16,903,070	72,768	2,076,876	31,153,140	134,114	3,060,016	45,900,242	197,601	4,585,426	68,781,388	296,104
Local from WB Domestic Loads	30.0	35,079	1,052,376	4,530	57,186	1,715,566	7,386	92,687	2,780,609	11,971	147,029	4,410,882	18,989
Repo Off-Hires from Depots	4.0	180,263	721,053	3,104	321,683	1,286,732	5,539	481,931	1,927,722	8,299	729,512	2,918,050	12,562
Local Empties from Transloads	10.0	131,075	1,310,746	5,643	217,613	2,176,125	9,368	320,354	3,203,541	13,791	478,423	4,784,234	20,596
Total		1,778,478	24,259,894	104,439	3,170,871	43,296,763	186,393	4,761,364	65,101,385	280,261	7,219,547	98,802,732	425,346
Cross-Town													
Local Off-Hires to Depots	11.0	43,555	479,107	2,063	79,349	872,841	3,758	116,773	1,284,504	5,530	174,745	1,922,194	8,275
IM Off-Hires to Depots	10.0	10,524	105,238	453	17,156	171,557	739	27,806	278,061	1,197	44,109	441,088	1,899
Re-used empties for exports	15.0	26,561	398,419	1,715	48,446	726,685	3,128	71,370	1,070,554	4,609	106,910	1,603,651	6,904
Total		80,640	982,764	4,231	144,951	1,771,083	7,625	215,949	2,633,119	11,336	325,764	3,966,933	17,078
Grand Total		2,563,067	34,385,909	148,031	4,752,541	64,040,254	275,693	6,877,133	92,374,112	397,671	10,170,973	136,322,325	586,868
Emissions (Tons) (c)													
Carbon Monoxide		13.12	497	2.1		925	4.0		1,335	5.7		1,970	8.5
Total Organic Gases		2.99	113	0.5		211	0.9		304	1.3		449	1.9
Reactive Organic Gases		2.92	111	0.5		206	0.9		297	1.3		438	1.9
Oxides of Nitrogen		11.10	420	1.8		783	3.4		1,129	4.9		1,666	7.2
Exhaust Particulates		1.03	39	0.2		73	0.3		105	0.5		155	0.7
(a) Average trip length based on port model origin/destination data as well as location of Depots and transloading facilities													
(b) Annual VMT converted to peak day VMT using peak month of 9.1% of annual, 28 working days per month, and peak day of 123% of average day.													
(c) based on EMFAC7F1.1 model year 2010 emissions factors													

Exhibit 32
Depot Direct Off-hire Impacts

Empty Trip Type	Average Trip Length (a) (miles)	2000			2010			2015			2020		
		Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)
Eastbound													
Off-Dock Intermodal	14.0	27,961	391,458	1,685	101,422	1,419,914	6,113	146,811	2,055,351	8,848	215,038	3,010,533	12,960
Local for Export Loading	15.0	549,804	8,247,056	35,504	1,110,119	16,651,782	71,686	1,415,657	21,234,851	91,416	1,899,966	28,499,492	122,690
SSL Off-Hires to Depots	4.0	0	0	0	0	0	0	0	0	0	0	0	0
Total		577,765	8,638,514	37,189	1,211,541	18,071,696	77,799	1,562,468	23,290,203	100,264	2,115,004	31,510,025	135,651
Westbound													
Off-Dock Intermodal	14.0	280,634	3,928,872	16,914	457,484	6,404,781	27,573	741,496	10,380,939	44,690	1,176,235	16,467,292	70,892
Local from Import Loads	15.0	1,025,243	15,378,638	66,205	1,891,728	28,375,917	122,158	2,787,546	41,813,184	180,006	4,177,688	62,665,316	269,774
Local from WB Domestic Loads	30.0	35,079	1,052,376	4,530	57,186	1,715,566	7,386	92,687	2,780,609	11,971	147,029	4,410,882	18,989
Repo Off-Hires from Depots	4.0	180,263	721,053	3,104	321,683	1,286,732	5,539	481,931	1,927,722	8,299	729,512	2,918,050	12,562
Local Empties from Transloads	10.0	131,075	1,310,746	5,643	217,613	2,176,125	9,368	320,354	3,203,541	13,791	478,423	4,784,234	20,596
Bobtails	15.0	0	0	0	0	0	0	0	0	0	0	0	0
Total		1,652,293	22,391,685	96,396	2,945,693	39,959,122	172,024	4,424,013	60,105,995	258,756	6,708,888	91,245,773	392,813
Cross-Town													
Local Off-Hires to Depots	11.0	145,184	1,597,025	6,875	264,497	2,909,471	12,525	389,244	4,281,679	18,433	582,483	6,407,313	27,583
IM Off-Hires to Depots	10.0	35,079	350,792	1,510	57,186	571,855	2,462	92,687	926,870	3,990	147,029	1,470,294	6,330
Re-used empties for exports	15.0	26,561	398,419	1,715	48,446	726,685	3,128	71,370	1,070,554	4,609	106,910	1,603,651	6,904
Total		206,825	2,346,236	10,101	370,129	4,208,012	18,115	553,301	6,279,103	27,032	836,422	9,481,258	40,817
Grand Total		2,436,883	33,376,434	143,686	4,527,363	62,238,830	267,938	6,539,781	89,675,301	386,052	9,660,315	132,237,056	569,281
Emissions (Tons) (c)													
Carbon Monoxide		13.12	482	2.1		899	3.9		1,296	5.6		1,911	8.2
Total Organic Gases		2.99	110	0.5		205	0.9		295	1.3		435	1.9
Reactive Organic Gases		2.92	107	0.5		200	0.9		288	1.2		425	1.8
Oxides of Nitrogen		11.10	408	1.8		761	3.3		1,096	4.7		1,617	7.0
Exhaust Particulates		1.03	38	0.2		71	0.3		102	0.4		150	0.6
(a) Average trip length based on port model origin/destination data as well as location of Depots and transloading facilities													
(b) Annual VMT converted to peak day VMT using peak month of 9.1% of annual, 28 working days per month, and peak day of 123% of average day.													

Exhibit 33
Combined Scenario Impacts

Empty Trip Type	Average Trip Length (a) (miles)	2000			2010			2015			2020		
		Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)
Eastbound													
Off-Dock Intermodal	14.0	27,961	391,458	1,685	101,422	1,419,914	6,113	146,811	2,055,351	8,848	215,038	3,010,533	12,960
Local for Export Loading	15.0	549,804	8,247,056	35,504	1,110,119	16,651,782	71,686	1,415,657	21,234,851	91,416	1,899,966	28,499,492	122,690
SSL Off-Hires to Depots	4.0	126,184	504,737	2,173	225,178	900,712	3,878	337,351	1,349,406	5,809	510,659	2,042,635	8,794
Total		703,949	9,143,251	39,362	1,436,719	18,972,408	81,676	1,899,819	24,639,608	106,074	2,625,663	33,552,660	144,444
Westbound													
Off-Dock Intermodal	14.0	305,189	4,272,648	18,394	497,514	6,965,200	29,985	806,377	11,289,272	48,600	1,279,156	17,908,180	77,095
Local from Import Loads	15.0	1,126,871	16,903,070	72,768	2,076,876	31,153,140	134,114	3,060,016	45,900,242	197,601	4,585,426	68,781,388	296,104
Local from WB Domestic Loads	30.0	35,079	1,052,376	4,530	57,186	1,715,566	7,386	92,687	2,780,609	11,971	147,029	4,410,882	18,989
Repo Off-Hires from Depots	4.0	180,263	721,053	3,104	321,683	1,286,732	5,539	481,931	1,927,722	8,299	729,512	2,918,050	12,562
Local Empties from Transloads	10.0	131,075	1,310,746	5,643	217,613	2,176,125	9,368	320,354	3,203,541	13,791	478,423	4,784,234	20,596
Total		1,778,478	24,259,894	104,439	3,170,871	43,296,763	186,393	4,761,364	65,101,385	280,261	7,219,547	98,802,732	425,346
Cross-Town													
Local Off-Hires to Depots	11.0	43,555	479,107	2,063	79,349	872,841	3,758	116,773	1,284,504	5,530	174,745	1,922,194	8,275
IM Off-Hires to Depots	10.0	10,524	105,238	453	17,156	171,557	739	27,806	278,061	1,197	44,109	441,088	1,899
Re-used empties for exports	15.0	26,561	398,419	1,715	48,446	726,685	3,128	71,370	1,070,554	4,609	106,910	1,603,651	6,904
Total		80,640	982,764	4,231	144,951	1,771,083	7,625	215,949	2,633,119	11,336	325,764	3,966,933	17,078
Grand Total		2,563,067	34,385,909	148,031	4,752,541	64,040,254	275,693	6,877,133	92,374,112	397,671	10,170,973	136,322,325	586,868
Emissions (Tons) (c)													
Carbon Monoxide		13.12	497	2.1		925	4.0		1,335	5.7		1,970	8.5
Total Organic Gases		2.99	113	0.5		211	0.9		304	1.3		449	1.9
Reactive Organic Gases		2.92	111	0.5		206	0.9		297	1.3		438	1.9
Oxides of Nitrogen		11.10	420	1.8		783	3.4		1,129	4.9		1,666	7.2
Exhaust Particulates		1.03	39	0.2		73	0.3		105	0.5		155	0.7
(a) Average trip length based on port model origin/destination data as well as location of Depots and transloading facilities													
(b) Annual VMT converted to peak day VMT using peak month of 9.1% of annual, 28 working days per month, and peak day of 123% of average day.													
(c) based on EMFAC7F1.1 model year 2010 emissions factors													

Vehicle Miles Traveled (VMT)

Annual TEU throughput and units representing each empty trip type were used to calculate the vehicle miles traveled (VMT) from the Ports. Unit movements were obtained for imports, exports, off-dock, local, and cross-town empty movements. Annual VMT were converted to peak day VMT by using a peak month factor of 9.1% of annual (based on data developed for the Ports Transportation Study), and the peak day was derived from peak month assuming 6.0 working days per week, 4.33 weeks per month, and a peak day 123% of average. VMT were then estimated by multiplying the average trip lengths by each empty container trip type as described in detail above. Exhibit 34 and Exhibit 35 below summarize the annual and peak day VMT reductions for the Reuse, Depot Direct, and Combined empty container strategy scenarios.

Exhibit 34
Annual Empty Container VMT

	2000	2010	2015	2020
Base Case	34,385,909	64,040,254	92,374,112	136,322,325
Tier I - 5% Reuse	33,188,403	61,852,813	89,151,532	131,494,795
VMT Reduction	1,197,505	2,187,441	3,222,579	4,827,530
Tier II - 10% Reuse	31,192,561	58,207,077	83,780,567	123,448,912
VMT Reduction	3,193,347	5,833,177	8,593,545	12,873,414
Depot-Direct 10%	33,376,434	62,238,830	89,675,301	132,237,056
VMT Reduction	1,009,474	1,801,424	2,698,811	4,085,269
Combined Scenario	30,242,584	56,514,171	81,241,625	119,603,121
VMT Reduction	4,143,324	7,526,083	11,132,487	16,719,205

Exhibit 35
Peak Day Empty Container VMT

	2000	2010	2015	2020
Base Case	148,031	275,693	397,671	586,868
Tier I - 5% Reuse	142,876	266,276	383,797	566,085
VMT Reduction	5,155	9,417	13,873	20,783
Tier II - 10% Reuse	134,284	250,581	360,675	531,448
VMT Reduction	13,747	25,112	36,995	55,420
Depot-Direct 10%	143,686	267,938	386,052	569,281
VMT Reduction	4,346	7,755	11,618	17,587
Combined Scenario	130,194	243,294	349,745	514,891
VMT Reduction	17,837	32,400	47,925	71,976

Emissions

The emissions estimates were based the combined total empty trip type (imports, exports and cross-town) and EMFAC7F1.1 model year 2010 emissions factors for each pollutant type (carbon monoxide, organic gasses, oxides of nitrogen, and particulate) Total emissions are directly correlated to VMT for each type of pollutant. Exhibit 37 on the next page displays the estimated emissions impacts for the Base Case and the three analysis scenarios.

Since the emissions are correlated to the VMT reductions, the largest categories of emissions for drayage tractors – carbon monoxide and oxides of nitrogen – show the largest reductions. The results are summarized below.

Exhibit 36

Emissions Summary				
Scenario & Emissions Type	2000		2020	
	Annual Tons	Peak Day Tons	Annual Tons	Peak Day Tons
Base Case				
Carbon Monoxide	497	2.14	1,970	8.48
Total Organic Gases	113	0.49	449	1.93
Reactive Organic Gases	111	0.48	438	1.89
Oxides of Nitrogen	420	1.81	1,666	7.17
Exhaust Particulates	39	0.17	155	0.67
Combined Scenario				
Carbon Monoxide	437	1.88	1,728	7.44
Reduction	60	0.26	242	1.04
Total Organic Gases	100	0.43	394	1.70
Reduction	14	0.06	55	0.24
Reactive Organic Gases	97	0.42	385	1.66
Reduction	13	0.06	54	0.23
Oxides of Nitrogen	370	1.59	1,462	6.29
Reduction	51	0.22	204	0.88
Exhaust Particulates	34	0.15	136	0.58
Reduction	5	0.02	19	0.08

Exhibit 37
Empty Container Strategy Scenario Emissions Impacts

Scenario & Emissions Type	2000		2010		2015		2020	
	Annual Tons	Peak Day Tons	Annual Tons	Peak Day Tons	Annual Tons	Peak Day Tons	Annual Tons	Peak Day Tons
Base Case								
Carbon Monoxide	497	2.14	925	3.98	1,335	5.75	1,970	8.48
Total Organic Gases	113	0.49	211	0.91	304	1.31	449	1.93
Reactive Organic Gases	111	0.48	206	0.89	297	1.28	438	1.89
Oxides of Nitrogen	420	1.81	783	3.37	1,129	4.86	1,666	7.17
Exhaust Particulates	39	0.17	73	0.31	105	0.45	155	0.67
Tier I - 5% Reuse								
Carbon Monoxide	480	2.06	894	3.85	1,288	5.55	1,900	8.18
Reduction	17	0.07	32	0.14	47	0.20	70	0.30
Total Organic Gases	109	0.47	204	0.88	294	1.26	433	1.86
Reduction	4	0.02	7	0.03	11	0.05	16	0.07
Reactive Organic Gases	107	0.46	199	0.86	287	1.23	423	1.82
Reduction	4	0.02	7	0.03	10	0.04	16	0.07
Oxides of Nitrogen	406	1.75	756	3.26	1,090	4.69	1,607	6.92
Reduction	15	0.06	27	0.12	39	0.17	59	0.25
Exhaust Particulates	38	0.16	70	0.30	101	0.44	149	0.64
Reduction	1	0.01	2	0.01	4	0.02	5	0.02
Tier II - 10% Reuse								
Carbon Monoxide	451	1.94	841	3.62	1,211	5.21	1,784	7.68
Reduction	46	0.20	84	0.36	124	0.53	186	0.80
Total Organic Gases	103	0.44	192	0.83	276	1.19	407	1.75
Reduction	11	0.05	19	0.08	28	0.12	42	0.18
Reactive Organic Gases	100	0.43	187	0.81	269	1.16	397	1.71
Reduction	10	0.04	19	0.08	28	0.12	41	0.18
Oxides of Nitrogen	381	1.64	712	3.06	1,024	4.41	1,617	6.96
Reduction	39	0.17	71	0.31	105	0.45	50	0.21
Exhaust Particulates	35	0.15	66	0.28	95	0.41	140	0.60
Reduction	4	0.02	7	0.03	10	0.04	15	0.06
Depot Direct: 10%								
Carbon Monoxide	482	2.08	899	3.87	1,296	5.58	1,911	8.23
Reduction	15	0.06	26	0.11	39	0.17	59	0.25
Total Organic Gases	110	0.47	205	0.88	295	1.27	435	1.87
Reduction	3	0.01	6	0.03	9	0.04	13	0.06
Reactive Organic Gases	107	0.46	200	0.86	288	1.24	425	1.83
Reduction	3	0.01	6	0.02	9	0.04	13	0.06
Oxides of Nitrogen	408	1.76	761	3.28	1,096	4.72	1,617	6.96
Reduction	12	0.05	22	0.09	33	0.14	50	0.21
Exhaust Particulates	38	0.16	71	0.30	102	0.44	150	0.65
Reduction	1	0.00	2	0.01	3	0.01	5	0.02
Combined Scenario								
Carbon Monoxide	437	1.88	817	3.52	1,174	5.05	1,728	7.44
Reduction	60	0.26	109	0.47	161	0.69	242	1.04
Total Organic Gases	100	0.43	186	0.80	268	1.15	394	1.70
Reduction	14	0.06	25	0.11	37	0.16	55	0.24
Reactive Organic Gases	97	0.42	182	0.78	261	1.12	385	1.66
Reduction	13	0.06	24	0.10	36	0.15	54	0.23
Oxides of Nitrogen	370	1.59	691	2.97	993	4.28	1,462	6.29
Reduction	51	0.22	92	0.40	136	0.59	204	0.88
Exhaust Particulates	34	0.15	64	0.28	92	0.40	136	0.58
Reduction	5	0.02	9	0.04	13	0.05	19	0.08

Benefit-Cost Tradeoffs

There are multiple parallel elements to the empty container logistics strategy that have benefits and cost implications.

The net public benefits of improved empty container logistics are significant reductions in regional truck VMT and emissions. Direct public-sector costs, if any, are likely to be minor.

The *net* private sector benefits are likely to be significant as well, encompassing reduced drayage trips, better equipment supply and control, reduced terminal gate costs, etc. The measurable net benefits to any one party, however, may be slim, and hard to measure. As explained in earlier sections, the success of an empty container logistics strategy depends on the balance of incentives.

Virtual Container Yard Benefits & Costs

The benefits of a virtual container yard would be widespread, although difficult for any one party to estimate in advance with precision.

- Truckers would benefit from reducing non-revenue return moves, improving driver productivity, and reducing the need to go to the harbor (and wait in marine terminal queues) for empties.
- Ocean carriers would benefit through improved equipment utilization and lower long-run trucking costs (reduced upward pressure on rates).
- Export shippers would benefit through improved equipment supply.
- The public would benefit through reduced total truck VMT, emissions, congestion, etc.

The physical operating costs would fall primarily on truckers, while managerial and clerical costs would be shared.

- Truckers would have to return selected empties to their yard or a neutral location, and incur costs for inspection and interchange procedures.
- Both ocean carriers and truckers would incur some cost for posting information and managing the process.

The benefits and costs, and the perspectives of each party, depend on whether the virtual CY is used to support empty container reuse, depot-direct off-hiring, or both.

Container Reuse Benefits and Costs

The private sector benefits and costs of increasing empty container reuse, whether through a virtual CY or existing means, include reduced drayage trips and improved equipment supply.

There would be slightly more than three one-way trips avoided for every container reused (including reduced bobtail outgates at the marine terminals, and at least one additional cross-town trip. Empty returns are a cost factor for the driver and drayage firm, and must be covered by the revenue from the loaded trip leg.

Operating costs, including owner-operator labor and overhead, average about \$80 for a two-hour, one-way trip leg (driving plus terminal time).

- The primary direct beneficiary of the changes may be the **owner-operator/driver**. Owner-operators are typically paid 70% of the drayage revenue, which is generated by the loaded move, and must accept the time and expense of empty returns and bobtail moves as a cost. To the extent that empty and bobtail moves will be avoided, the owner-operator's cost will be reduced while revenue remains unchanged. This savings would be offset by additional cross-town trips required to reposition or interchange the empty. Reducing the need for non-revenue moves would also free-up driver and tractor time for additional revenue trips, increasing the driver's productivity and earning power.
- Benefits to the **drayage firm** would include increased driver productivity and revenue potential, improved customer relations and retention, and reduced upward cost pressure. At present, drayage drivers are in short supply while competition keeps rates low, so drayage firms would welcome increased productivity. The drayage firm would also have the same revenue, but could experience increased clerical, dispatching, and management costs as a consequence of the more complex reuse transaction. The drayage firm may also have to arrange for additional parking space to hold and interchange empties. If the drayage firm employs the drivers and owns the tractors, the benefits of trip reduction may be felt more directly.
- **Ocean carriers** would benefit from increased container productivity, reduced gate transaction cost, reduced on-terminal empty container inventory and storage, and improved customer relations. Ocean carriers, like drayage firms, would experience some additional overhead cost to support the street turn process.
- Benefits to **customers** (shippers and consignees) would be less tangible, and would consist primarily of improved empty equipment supply and reduced upward pressure on long-term drayage rates for loaded moves.

The key trade-off rests with the drayage firms, since they will have to take the initiative to locate and exploit reuse opportunities. At present, reuse is mostly limited to "easy" opportunities within the customer base of each drayage firm, and rarely involve off-dock interchanges. To encourage the drayage firms to seek reuse opportunities more aggressively, ocean carriers may have to offer incentives to tip the balance.

Depot-Direct Off-Hiring Benefits and Costs

As with empty container reuse, the cost/benefit tradeoff for depot-direct off-hires rests primarily on the **drayage firm**. Under existing practices truckers would only benefit if compensated for detours to depots, since they would incur additional driving and terminal time. Truckers do not always welcome the existing volume of depot-direct off-hires.

- Chassis are more expensive, in shorter supply, and harder to store than containers. Truckers would ordinarily drop the empty container at the depot but still return the chassis to the marine terminal. Entering the terminal as a bobtail does not require interchange or inspection, but bringing in an empty chassis requires both. The trucker would not save much, if any time at the terminal gate, and would have spent additional time at the depot.
- Truckers may not be willing to participate if non-revenue depot-direct off-hires divert drivers in peak periods, when driver productivity is critical to handle revenue moves.

Appropriate trucker compensation could be weighed against savings to ocean carriers or leasing companies from additional drays and reduced empty storage costs.

Ocean carriers would incur management costs for additional planning, and incur information systems costs. Ocean carriers would, however, benefit from expedited off-hires, from reduced total drayage moves and expense, from reduced gate charges, and reduced storage costs.

As discussed earlier, chassis pooling systems that allow a trucker to reuse a chassis for another load at the marine terminal instead of interchanging it at the gate would favorably alter the economics and encourage trucker participation.

System User Fees

When this study was originally proposed, there were no private sector Internet-based systems such as eModal, InterBox, or SynchroMet to facilitate empty container reuse. It was thought that significant public sector initiative and investment might be needed to develop and implement such a system. Events have bypassed this issue, and the private sector is moving ahead rapidly.

User fees are a major issue for the Internet-based systems. Proposals for fee-based systems have met with opposition elsewhere, as did one previous attempt in Southern California. As noted earlier the economics of empty container reuse are not overwhelmingly positive, and it may be difficult for drayage firms to realize and recognize savings to offset the costs. User fees for Internet-based information systems are tangible, and none of the parties to the transaction are accustomed to paying for information. User fees may be a stumbling block to implementation.

- InterBox and SynchroMet are private, for-profit systems financed through access fees. Both systems expect to deliver significant, measurable economic benefits to their users, and charge accordingly.

- eModal does not yet charge a fee for access to the system. In the long run, the economics of the situation may force eModal to introduce user fees of some kind.

The Ports of Long Beach, Los Angeles, and Oakland have supported the development of eModal, and Oakland has supported the development of SynchroMet. The public has increasingly held the ports responsible (rightly or wrongly) for growing truck traffic and expected the ports to contribute to a solution. Relatively modest investment in systems development appears to be a prudent port response. To the extent that port support reduces private capital requirements and risk, the need for system user fees should be reduced.

The acceptance of user fees and the use of these systems should be carefully monitored to insure that fees do not become a barrier to increased empty reuse and depot-direct off-hiring. Should they become a barrier, public subsidy might be considered as an option.

Container Depot Capacity

As implied in previous sections, the intermodal industry is moving steadily in the desired direction with minimal public intervention or assistance. The study team sees a limited but important future role for public agencies in supporting an empty container logistics strategy:

- Support for the future development and expansion of Internet-based information systems. The Ports of Los Angeles and Long Beach have supported the development and expansion of eModal. Although all the candidate systems have been developed as commercial ventures, there is a significant public interest content in their success.
- Planning for adequate container depot capacity and access. Container depots find it difficult to increase their capacity and capabilities, and may not be able to support the full development of off-dock depot and off-hiring functions under present conditions.

Container depot capacity may thus be the only significant public planning need in an empty container logistics strategy:

- Container depots are becoming capacity constrained.
- Suitable land is becoming harder to find and local opposition to higher stacking is growing.

As depot capacity becomes tighter and costs rise, off-dock storage of empties becomes less attractive and empty returns to the marine terminal more attractive. Depot capacity is a function of size (acreage) and stacking height.

- Depot operators contacted in the course of this and other studies have reported difficulty in expanding at existing locations or securing new sites in the same general area. The alternative to site expansion is higher stacking.

- Where permitted, North American depot operators prefer to stack containers six-high (seven-high stacking is used overseas), although the average is lower. A stack of six containers is 48-57 feet high, the rough equivalent of a six-story building. Many communities object to such large container stacks, and there has been community pressure in Southern California and elsewhere to limit the height of container stacks.

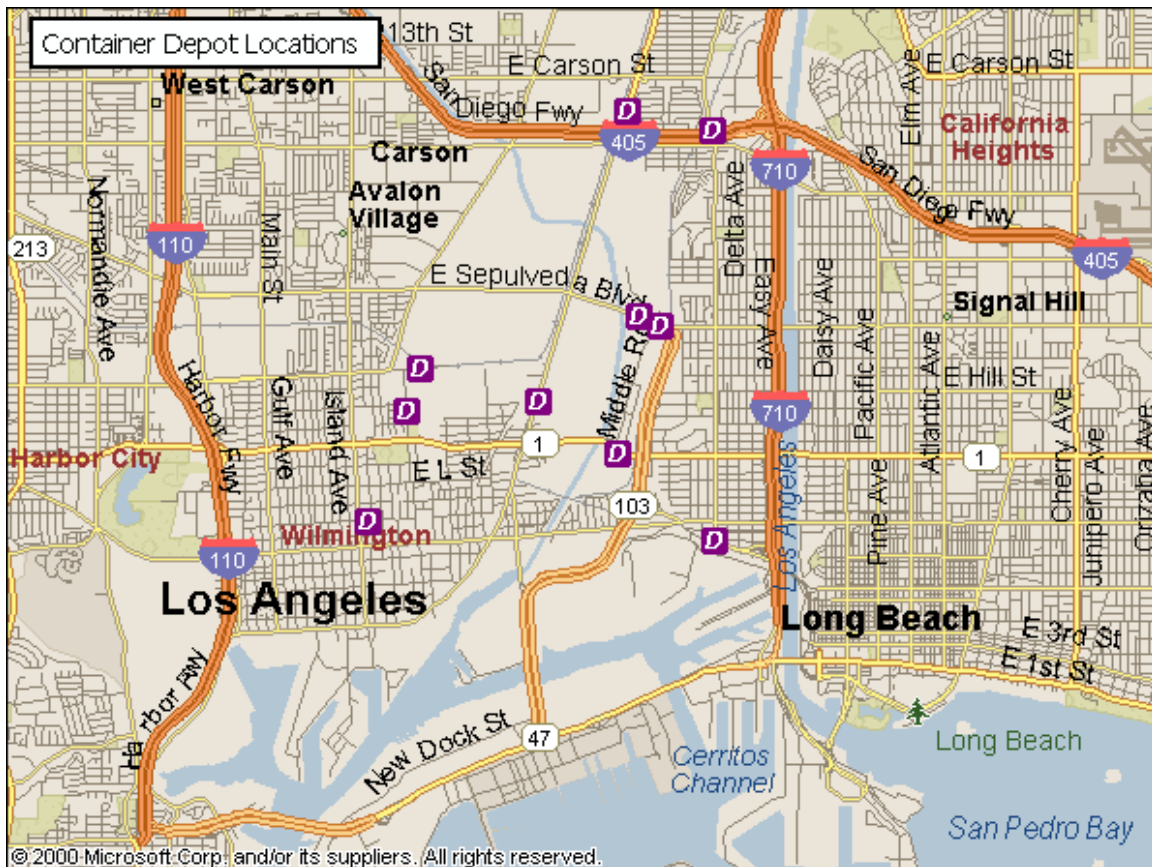
The aerial photo in Exhibit 38 below shows a container depot on East Opp Street in a mixed commercial/industrial area of Wilmington. The prominence of the depot is obvious (note the shadows of the container stacks), as is the tightly constrained site. The expansion ability of this heavily-used depot, like other depots in similar circumstances, depends on the willingness of local planning authorities to allow such land uses on adjacent parcels.

Exhibit 38
Container Depot



As depots are forced to located farther from the ports, the potential VMT savings may be reduced. Exhibit 39 below shows the approximate locations of container depots in the port area (actual locations may have changed since the data were gathered). Most are clustered in the area north of the ports bounded by I-110, I-405, and I-710. This area has historically been home to numerous light and heavy industrial uses.

Exhibit 39
Container Depot Locations



The ability of container depots to offer adequate capacity near the ports is critical to any increase in depot-direct off-hiring or any long-term potential development of off-dock empty return depots. As noted in the section that follows, the economics of depot-direct off-hiring are not so compelling as to justify significant detours by draymen, and the longer the detour the more the drayman must be compensated. In addition, the VMT and emissions savings associated with depot strategies depend on the detour length: the farther the drayman must go out of his way, the less the VMT and emissions savings.

Most existing depot capacity is about 4 miles from the ports, and 1-2 miles from the nearest I-710 exit. This defines a fairly narrow area in which to locate more depot capacity to accommodate cargo growth and change in empty container logistics. Communities in this area, like communities elsewhere, are becoming increasingly sensitive to industrial development and truck traffic. Container depots have become the focal points of public land-use planning and zoning controversies in San Pedro, Oakland, Chicago, and elsewhere.

Container depot capacity, like highway capacity, is an essential support function for cargo growth, and will require constructive attention as part of an empty container logistics strategy.

On-Going Research Needs

While the outlines of the empty container logistics challenge and a short-term logistics strategy are clear, there remain numerous unanswered detail questions and points where estimates have been made in the absence of solid data. As the marine intermodal industry moves toward additional reuse flexibility, depot-direct off-hire, and the use of Internet-based systems, both private and public interests would be served by additional research into some of the issues below:

- **Off-dock container depot storage and land requirements.** Container depots are typically located very close to the ports, where appropriate land has historically been available and inexpensive. Port growth and adjacent industrial/commercial growth have tightened the supply of land at the same time that community concerns have limited the ability of existing depots to expand. Research is needed into the long-term regional depot requirements and associated location issues.
- **Westbound domestic backhaul container loads and logistics.** As the report notes, there are no data on how often westbound ISO containers are used for domestic goods or how those containers move through Southern California. All existing discussions are based on rough estimates.
- **Off-hiring movements and logistics.** This has been the first study to discuss the movement of empty containers for off-hiring in any depth. Since these complex movements account for a significant volume of port-area truck traffic, it would be useful to understand these operations in greater detail.

Appendix A: Interstate 710 Impacts

The study team was requested to identify the impacts of the various scenarios on Interstate 710. The basis for these impact allocations is the expanded trip length summary below, which gives the estimated average trip length on the 710 for each trip type. Note that each type of trip has an *average* mileage on I-710, even though some trips may not use I-710 at all.

Exhibit 40
I-710 Trip Length Summary

Trip Type	Average Miles	Est 710 Miles
Eastbound		
Off-Dock Intermodal	14	11
Local for Export Loading	15	10
SSL Off-Hires to Depots	4	1.5
Westbound		
Off-Dock Intermodal	14	11
Local from Import Loads	15	10
Local from WB Domestic Loads	30	17.5
Repo Off-Hires from Depots	4	1.5
Local Empties from Transloads	10	6
Bobtails	15	10
Cross-Town		
Local Off-Hires to Depots	11	8.5
IM Off-Hires to Depots	10	8.5
Re-used empties for exports	15	10

The series of Exhibits that follows gives VMT and emissions impact estimates for I-710.

Exhibit 41
Base Case I-710 Impacts

Empty Trip Type	Est. 710 Trip Length (a) (miles)	2000			2010			2015			2020		
		Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)
Eastbound													
Off-Dock Intermodal	11.0	27,961	307,574	1,324	101,422	1,115,647	4,803	146,811	1,614,919	6,952	215,038	2,365,418	10,183
Local for Export Loading	10.0	549,804	5,498,037	23,669	1,110,119	11,101,188	47,791	1,415,657	14,156,568	60,944	1,899,966	18,999,662	81,794
SSL Off-Hires to Depots	1.5	126,184	189,276	815	225,178	337,767	1,454	337,351	506,027	2,178	510,659	765,988	3,298
Total		703,949	5,994,888	25,808	1,436,719	12,554,602	54,048	1,899,819	16,277,514	70,075	2,625,663	22,131,068	95,274
Westbound													
Off-Dock Intermodal	11.0	305,189	3,357,081	14,452	497,514	5,472,657	23,560	806,377	8,870,142	38,186	1,279,156	14,070,713	60,574
Local from Import Loads	10.0	1,126,871	11,268,713	48,512	2,076,876	20,768,760	89,410	3,060,016	30,600,161	131,734	4,585,426	45,854,259	197,403
Local from WB Domestic Loads	17.5	35,079	613,886	2,643	57,186	1,000,747	4,308	92,687	1,622,022	6,983	147,029	2,573,014	11,077
Repo Off-Hires from Depots	1.5	180,263	270,395	1,164	321,683	482,524	2,077	481,931	722,896	3,112	729,512	1,094,269	4,711
Local Empties from Transloads	6.0	131,075	786,447	3,386	217,613	1,305,675	5,621	320,354	1,922,124	8,275	478,423	2,870,540	12,358
Total		1,778,478	16,296,523	70,157	3,170,871	29,030,363	124,976	4,761,364	43,737,345	188,289	7,219,547	66,462,794	286,122
Cross-Town													
Local Off-Hires to Depots	8.5	43,555	370,219	1,594	79,349	674,468	2,904	116,773	992,571	4,273	174,745	1,485,332	6,394
IM Off-Hires to Depots	8.5	10,524	89,452	385	17,156	145,823	628	27,806	236,352	1,017	44,109	374,925	1,614
Re-used empties for exports	10.0	26,561	265,612	1,143	48,446	484,457	2,086	71,370	713,703	3,072	106,910	1,069,101	4,602
Total		80,640	725,284	3,122	144,951	1,304,748	5,617	215,949	1,942,626	8,363	325,764	2,929,357	12,611
Grand Total		2,563,067	23,016,695	99,087	4,752,541	42,889,713	184,640	6,877,133	61,957,484	266,727	10,170,973	91,523,220	394,007
Emissions (Tons) (c)													
Carbon Monoxide		13.12	333	1.4		620	2.7		895	3.9		1,322	5.7
Total Organic Gases		2.99	76	0.3		141	0.6		204	0.9		301	1.3
Reactive Organic Gases		2.92	74	0.3		138	0.6		199	0.9		294	1.3
Oxides of Nitrogen		11.10	281	1.2		524	2.3		757	3.3		1,119	4.8
Exhaust Particulates		1.03	26	0.1		49	0.2		70	0.3		104	0.4

(a) Average trip length based on port model origin/destination data as well as location of Depots and transloading facilities

(b) Annual VMT converted to peak day VMT using peak month of 9.1% of annual, 28 working days per month, and peak day of 123% of average day.

(c) based on EMFAC7F1.1 model year 2010 emissions factors

Exhibit 42
Tier I 5% Reuse I-710 Impacts

Empty Trip Type	Est. 710 Trip Length (a) (miles)	2000			2010			2015			2020		
		Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)
Eastbound													
Off-Dock Intermodal	11.0	27,961	307,574	1,324	101,422	1,115,647	4,803	146,811	1,614,919	6,952	215,038	2,365,418	10,183
Local for Export Loading	10.0	509,962	5,099,618	21,954	1,037,450	10,374,503	44,662	1,308,601	13,086,014	56,335	1,739,601	17,396,010	74,890
SSL Off-Hires to Depots	1.5	123,395	185,093	797	220,091	330,137	1,421	329,858	494,786	2,130	499,433	749,150	3,225
Total		661,319	5,592,286	24,075	1,358,964	11,820,287	50,886	1,785,270	15,195,719	65,418	2,454,072	20,510,578	88,298
Westbound													
Off-Dock Intermodal	11.0	305,189	3,357,081	14,452	497,514	5,472,657	23,560	806,377	8,870,142	38,186	1,279,156	14,070,713	60,574
Local from Import Loads	10.0	1,092,237	10,922,372	47,021	2,013,049	20,130,491	86,662	2,965,979	29,659,791	127,685	4,444,517	44,445,173	191,336
Local from WB Domestic Loads	17.5	35,079	613,886	2,643	57,186	1,000,747	4,308	92,687	1,622,022	6,983	147,029	2,573,014	11,077
Repo Off-Hires from Depots	1.5	176,279	264,419	1,138	314,416	471,624	2,030	471,225	706,838	3,043	713,476	1,070,214	4,607
Local Empties from Transloads	6.0	127,062	762,373	3,282	210,951	1,265,706	5,449	310,547	1,863,284	8,021	463,778	2,782,666	11,979
Bobtails	10.0	-39,842	-398,419	-1,715	-72,669	-726,685	-3,128	-107,055	-1,070,554	-4,609	-160,365	-1,603,651	-6,904
Total		1,696,005	15,521,712	66,821	3,020,447	27,614,540	118,881	4,539,760	41,651,522	179,310	6,887,591	63,338,129	272,671
Cross-Town													
Local Off-Hires to Depots	8.5	42,360	360,060	1,550	77,169	655,938	2,824	113,561	965,272	4,155	169,934	1,444,439	6,218
IM Off-Hires to Depots	8.5	10,524	89,452	385	17,156	145,823	628	27,806	236,352	1,017	44,109	374,925	1,614
Re-used empties for exports	10.0	66,403	664,031	2,859	121,114	1,211,142	5,214	178,426	1,784,257	7,681	267,275	2,672,752	11,506
Total		119,287	1,113,543	4,794	215,439	2,012,903	8,666	319,793	2,985,881	12,854	481,318	4,492,116	19,339
Grand Total		2,476,610	22,227,540	95,690	4,594,850	41,447,729	178,432	6,644,822	59,833,122	257,582	9,822,981	88,340,823	380,307
Emissions (Tons) (c)													
Carbon Monoxide		13.12	321	1.4		599	2.6		865	3.7		1,276	5.5
Total Organic Gases		2.99	73	0.3		136	0.6		197	0.8		291	1.3
Reactive Organic Gases		2.92	71	0.3		133	0.6		192	0.8		284	1.2
Oxides of Nitrogen		11.10	272	1.2		507	2.2		731	3.1		1,080	4.6
Exhaust Particulates		1.03	25	0.1		47	0.2		68	0.3		100	0.4
(a) Average trip length based on port model origin/destination data as well as location of Depots and transloading facilities													
(b) Annual VMT converted to peak day VMT using peak month of 9.1% of annual, 28 working days per month, and peak day of 123% of average day.													

Exhibit 43
Tier II 10% Reuse I-710 Impacts

Empty Trip Type	Average Trip Length (a) (miles)	2000			2010			2015			2020		
		Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)
Eastbound													
Off-Dock Intermodal	11.0	27,961	307,574	1,324	101,422	1,115,647	4,803	146,811	1,614,919	6,952	215,038	2,365,418	10,183
Local for Export Loading	10.0	443,559	4,435,587	19,095	916,336	9,163,362	39,448	1,130,176	11,301,757	48,654	1,472,326	14,723,258	63,384
SSL Off-Hires to Depots	1.5	118,747	178,121	767	211,613	317,420	1,366	317,368	476,052	2,049	480,724	721,086	3,104
Total		590,267	4,921,282	21,186	1,229,372	10,596,428	45,618	1,594,354	13,392,727	57,656	2,168,088	17,809,762	76,671
Westbound													
Off-Dock Intermodal	11.0	305,189	3,357,081	14,452	497,514	5,472,657	23,560	806,377	8,870,142	38,186	1,279,156	14,070,713	60,574
Local from Import Loads	10.0	1,034,514	10,345,137	44,536	1,906,671	19,066,711	82,082	2,809,251	28,092,508	120,938	4,209,670	42,096,697	181,226
Local from WB Domestic Loads	17.5	35,079	613,886	2,643	57,186	1,000,747	4,308	92,687	1,622,022	6,983	147,029	2,573,014	11,077
Repo Off-Hires from Depots	1.5	169,639	254,458	1,095	302,305	453,457	1,952	453,382	680,074	2,928	686,748	1,030,123	4,435
Local Empties from Transloads	6.0	120,375	722,248	3,109	199,848	1,199,090	5,162	294,203	1,765,216	7,599	439,368	2,636,210	11,349
Bobtails	10.0	-106,245	-1,062,450	-4,574	-193,783	-1,937,827	-8,342	-285,481	-2,854,811	-12,290	-427,640	-4,276,403	-18,410
Total		1,558,550	14,230,360	61,262	2,769,741	25,254,834	108,722	4,170,418	38,175,151	164,344	6,334,331	58,130,353	250,251
Cross-Town													
Local Off-Hires to Depots	8.5	40,368	343,127	1,477	73,536	625,054	2,691	108,209	919,773	3,960	161,916	1,376,283	5,925
IM Off-Hires to Depots	8.5	10,524	89,452	385	17,156	145,823	628	27,806	236,352	1,017	44,109	374,925	1,614
Re-used empties for exports	10.0	132,806	1,328,062	5,717	242,228	2,422,283	10,428	356,851	3,568,514	15,362	534,550	5,345,504	23,012
Total		183,698	1,760,641	7,580	332,920	3,193,160	13,747	492,866	4,724,639	20,340	740,575	7,096,713	30,551
Grand Total		2,332,515	20,912,283	90,027	4,332,033	39,044,423	168,086	6,257,639	56,292,517	242,339	9,242,994	83,036,828	357,474
Emissions (Tons) (c)													
Carbon Monoxide	13.12	302	1.3			564	2.4		813	3.5		1,200	5.2
Total Organic Gases	2.99	69	0.3			129	0.6		185	0.8		273	1.2
Reactive Organic Gases	2.92	67	0.3			126	0.5		181	0.8		267	1.1
Oxides of Nitrogen	11.10	256	1.1			477	2.1		688	3.0		1,015	4.4
Exhaust Particulates	1.03	24	0.1			44	0.2		64	0.3		94	0.4
(a) Average trip length based on port model origin/destination data as well as location of Depots and transloading facilities													
(b) Annual VMT converted to peak day VMT using peak month of 9.1% of annual, 28 working days per month, and peak day of 123% of average day.													
(c) based on EMFAC7F1.1 model year 2010 emissions factors													

Exhibit 44
Depot-Direct I-710 Impacts

Empty Trip Type	Average Trip Length (a) (miles)	2000			2010			2015			2020		
		Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)
Eastbound													
Off-Dock Intermodal	11.0	27,961	307,574	1,324	101,422	1,115,647	4,803	146,811	1,614,919	6,952	215,038	2,365,418	10,183
Local for Export Loading	10.0	549,804	5,498,037	23,669	1,110,119	11,101,188	47,791	1,415,657	14,156,568	60,944	1,899,966	18,999,662	81,794
SSL Off-Hires to Depots	1.5	0	0	0	0	0	0	0	0	0	0	0	0
Total		577,765	5,805,611	24,993	1,211,541	12,216,835	52,593	1,562,468	15,771,486	67,896	2,115,004	21,365,080	91,977
Westbound													
Off-Dock Intermodal	11.0	280,634	3,086,971	13,289	457,484	5,032,328	21,664	741,496	8,156,452	35,114	1,176,235	12,938,586	55,701
Local from Import Loads	10.0	1,025,243	10,252,425	44,137	1,891,728	18,917,278	81,439	2,787,546	27,875,456	120,004	4,177,688	41,776,878	179,849
Local from WB Domestic Loads	17.5	35,079	613,886	2,643	57,186	1,000,747	4,308	92,687	1,622,022	6,983	147,029	2,573,014	11,077
Repo Off-Hires from Depots	1.5	180,263	270,395	1,164	321,683	482,524	2,077	481,931	722,896	3,112	729,512	1,094,269	4,711
Local Empties from Transloads	6.0	131,075	786,447	3,386	217,613	1,305,675	5,621	320,354	1,922,124	8,275	478,423	2,870,540	12,358
Bobtails	10.0	0	0	0	0	0	0	0	0	0	0	0	0
Total		1,652,293	15,010,124	64,619	2,945,693	26,738,553	115,109	4,424,013	40,298,950	173,487	6,708,888	61,253,287	263,695
Cross-Town													
Local Off-Hires to Depots	8.5	145,184	1,234,065	5,313	264,497	2,248,228	9,679	389,244	3,308,570	14,243	582,483	4,951,106	21,315
IM Off-Hires to Depots	8.5	35,079	298,173	1,284	57,186	486,077	2,093	92,687	787,839	3,392	147,029	1,249,750	5,380
Re-used empties for exports	10.0	26,561	265,612	1,143	48,446	484,457	2,086	71,370	713,703	3,072	106,910	1,069,101	4,602
Total		206,825	1,797,850	7,740	370,129	3,218,762	13,857	553,301	4,810,112	20,708	836,422	7,269,956	31,297
Grand Total		2,436,883	22,613,586	97,351	4,527,363	42,174,149	181,560	6,539,781	60,880,549	262,091	9,660,315	89,888,323	386,969
Emissions (Tons) (c)													
Carbon Monoxide		13.12	327	1.4		609	2.6		880	3.8		1,299	5.6
Total Organic Gases		2.99	74	0.3		139	0.6		200	0.9		296	1.3
Reactive Organic Gases		2.92	73	0.3		136	0.6		196	0.8		289	1.2
Oxides of Nitrogen		11.10	276	1.2		516	2.2		744	3.2		1,099	4.7
Exhaust Particulates		1.03	26	0.1		48	0.2		69	0.3		102	0.4
(a) Average trip length based on port model origin/destination data as well as location of Depots and transloading facilities													
(b) Annual VMT converted to peak day VMT using peak month of 9.1% of annual, 28 working days per month, and peak day of 123% of average day.													

Exhibit 45
Combined Scenario I-710 Impacts

Empty Trip Type	Average Trip Length (a) (miles)	2000			2010			2015			2020		
		Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)	Units	Annual VMT (b)	Peak Day VMT (b)
Eastbound													
Off-Dock Intermodal	11.0	27,961	307,574	1,324	101,422	1,115,647	4,803	146,811	1,614,919	6,952	215,038	2,365,418	10,183
Local for Export Loading	10.0	443,559	4,435,587	19,095	916,336	9,163,362	39,448	1,130,176	11,301,757	48,654	1,472,326	14,723,258	63,384
SSL Off-Hires to Depots	1.5	0	0	0	0	0	0	0	0	0	0	0	0
Total		471,520	4,743,162	20,419	1,017,759	10,279,008	44,251	1,276,986	12,916,676	55,606	1,687,364	17,088,677	73,567
Westbound													
Off-Dock Intermodal	11.0	280,634	3,086,971	13,289	457,484	5,032,328	21,664	741,496	8,156,452	35,114	1,176,235	12,938,586	55,701
Local from Import Loads	10.0	940,322	9,403,220	40,481	1,735,088	17,350,877	74,696	2,556,764	25,567,640	110,069	3,831,866	38,318,664	164,962
Local from WB Domestic Loads	17.5	35,079	613,886	2,643	57,186	1,000,747	4,308	92,687	1,622,022	6,983	147,029	2,573,014	11,077
Repo Off-Hires from Depots	1.5	169,639	254,458	1,095	302,305	453,457	1,952	453,382	680,074	2,928	686,748	1,030,123	4,435
Local Empties from Transloads	6.0	120,375	722,248	3,109	199,848	1,199,090	5,162	294,203	1,765,216	7,599	439,368	2,636,210	11,349
Bobtails	10.0	-106,245	-1,062,450	-4,574	-193,783	-1,937,827	-8,342	-285,481	-2,854,811	-12,290	-427,640	-4,276,403	-18,410
Total		1,439,803	13,018,333	56,044	2,558,128	23,098,672	99,440	3,853,051	34,936,593	150,402	5,853,607	53,220,194	229,113
Cross-Town													
Local Off-Hires to Depots	8.5	134,560	1,143,756	4,924	245,119	2,083,512	8,970	360,695	3,065,912	13,199	539,719	4,587,611	19,750
IM Off-Hires to Depots	8.5	35,079	298,173	1,284	57,186	486,077	2,093	92,687	787,839	3,392	147,029	1,249,750	5,380
Re-used empties for exports	10.0	132,806	1,328,062	5,717	242,228	2,422,283	10,428	356,851	3,568,514	15,362	534,550	5,345,504	23,012
Total		302,445	2,769,992	11,925	544,533	4,991,873	21,490	810,234	7,422,264	31,953	1,221,299	11,182,865	48,142
Grand Total		2,213,768	20,531,486	88,388	4,120,419	38,369,553	165,181	5,940,271	55,275,533	237,961	8,762,270	81,491,736	350,822
Emissions (Tons) (c)													
Carbon Monoxide		13.12	297	1.3		554	2.4		799	3.4		1,178	5.1
Total Organic Gases		2.99	68	0.3		126	0.5		182	0.8		268	1.2
Reactive Organic Gases		2.92	66	0.3		123	0.5		178	0.8		262	1.1
Oxides of Nitrogen		11.10	251	1.1		469	2.0		676	2.9		996	4.3
Exhaust Particulates		1.03	23	0.1		44	0.2		63	0.3		92	0.4
(a) Average trip length based on port model origin/destination data as well as location of Depots and transloading facilities													
(b) Annual VMT converted to peak day VMT using peak month of 9.1% of annual, 28 working days per month, and peak day of 123% of average day.													
(c) based on EMFAC7F1.1 model year 2010 emissions factors													

Exhibit 46
I-710 Annual VMT Summary

	2000	2010	2015	2020
Base Case	23,016,695	42,889,713	61,957,484	91,523,220
Tier I - 5% Reuse	22,227,540	41,447,729	59,833,122	88,340,823
VMT Reduction	789,154	1,441,984	2,124,363	3,182,397
Tier II - 10% Reuse	20,912,283	39,044,423	56,292,517	83,036,828
VMT Reduction	2,104,411	3,845,291	5,664,967	8,486,391
Depot-Direct 10%	22,613,586	42,174,149	60,880,549	89,888,323
VMT Reduction	403,108	715,564	1,076,935	1,634,897
Combined Scenario	20,531,486	38,369,553	55,275,533	81,491,736
VMT Reduction	2,485,208	4,520,160	6,681,951	10,031,483

Exhibit 47
I-710 Peak Day VMT Summary

	2000	2010	2015	2020
Base Case	99,087	184,640	266,727	394,007
Tier I - 5% Reuse	95,690	178,432	257,582	380,307
VMT Reduction	3,397	6,208	9,145	13,700
Tier II - 10% Reuse	90,027	168,086	242,339	357,474
VMT Reduction	9,059	16,554	24,388	36,534
Depot-Direct 10%	97,351	181,560	262,091	386,969
VMT Reduction	1,735	3,081	4,636	7,038
Combined Scenario	88,388	165,181	237,961	350,822
VMT Reduction	10,699	19,459	28,766	43,186

Exhibit 48
I-710 Emissions Summary

I-710 Scenario & Emissions Type	2000		2010		2015		2020	
	Annual Tons	Peak Day Tons	Annual Tons	Peak Day Tons	Annual Tons	Peak Day Tons	Annual Tons	Peak Day Tons
Base Case								
Carbon Monoxide	333	1.43	620	2.67	895	3.85	1,322	5.69
Total Organic Gases	76	0.33	141	0.61	204	0.88	301	1.30
Reactive Organic Gases	74	0.32	138	0.59	199	0.86	294	1.27
Oxides of Nitrogen	281	1.21	524	2.26	757	3.26	1,119	4.82
Exhaust Particulates	26	0.11	49	0.21	70	0.30	104	0.45
Tier I - 5% Reuse								
Carbon Monoxide	321	1.38	599	2.58	865	3.72	1,276	5.50
Reduction	11	0.05	21	0.09	31	0.13	46	0.20
Total Organic Gases	73	0.32	136	0.59	197	0.85	291	1.25
Reduction	3	0.01	5	0.02	7	0.03	10	0.05
Reactive Organic Gases	71	0.31	133	0.57	192	0.83	284	1.22
Reduction	3	0.01	5	0.02	7	0.03	10	0.04
Oxides of Nitrogen	272	1.17	507	2.18	731	3.15	1,080	4.65
Reduction	10	0.04	18	0.08	26	0.11	39	0.17
Exhaust Particulates	25	0.11	47	0.20	68	0.29	100	0.43
Reduction	1	0.00	2	0.01	2	0.01	4	0.02
Tier II - 10% Reuse								
Carbon Monoxide	302	1.30	564	2.43	813	3.50	1,200	5.17
Reduction	30	0.13	56	0.24	82	0.35	123	0.53
Total Organic Gases	69	0.30	129	0.55	185	0.80	273	1.18
Reduction	7	0.03	13	0.05	19	0.08	28	0.12
Reactive Organic Gases	67	0.29	126	0.54	181	0.78	267	1.15
Reduction	7	0.03	12	0.05	18	0.08	27	0.12
Oxides of Nitrogen	256	1.10	477	2.05	688	2.96	1,015	4.37
Reduction	26	0.11	47	0.20	69	0.30	104	0.45
Exhaust Particulates	24	0.10	44	0.19	64	0.27	94	0.41
Reduction	2	0.01	4	0.02	6	0.03	10	0.04
Depot Direct: 10%								
Carbon Monoxide	327	1.41	609	2.62	880	3.79	1,299	5.59
Reduction	6	0.03	10	0.04	16	0.07	24	0.10
Total Organic Gases	74	0.32	139	0.60	200	0.86	296	1.27
Reduction	1	0.01	2	0.01	4	0.02	5	0.02
Reactive Organic Gases	73	0.31	136	0.58	196	0.84	289	1.24
Reduction	1	0.01	2	0.01	3	0.01	5	0.02
Oxides of Nitrogen	276	1.19	516	2.22	744	3.20	1,099	4.73
Reduction	5	0.02	9	0.04	13	0.06	20	0.09
Exhaust Particulates	26	0.11	48	0.21	69	0.30	102	0.44
Reduction	0	0.00	1	0.00	1	0.01	2	0.01
Combined Scenario								
Carbon Monoxide	297	1.28	554	2.39	799	3.44	1,178	5.07
Reduction	36	0.15	65	0.28	97	0.42	145	0.62
Total Organic Gases	68	0.29	126	0.54	182	0.78	268	1.16
Reduction	8	0.04	15	0.06	22	0.09	33	0.14
Reactive Organic Gases	66	0.28	123	0.53	178	0.77	262	1.13
Reduction	8	0.03	15	0.06	21	0.09	32	0.14
Oxides of Nitrogen	251	1.08	469	2.02	676	2.91	996	4.29
Reduction	30	0.13	55	0.24	82	0.35	123	0.53
Exhaust Particulates	23	0.10	44	0.19	63	0.27	92	0.40
Reduction	3	0.01	5	0.02	8	0.03	11	0.05